THURSDAY, APRIL 20, 1876

CAMPBELL'S "CIRCULAR NOTES"

My Circular Notes. Extracts from Journals, Letters sent home, Geological and other Notes, written while Travelling Westwards round the World, from July 6, 1874, to July 6, 1875. By J. F. Campbell, Author of "Frost and Fire." 2 vols. (London: Macmillan and Co., 1876.)

ALL who are acquainted with the undoubted merits of Mr. Campbell's earlier work—merits to which not even the most serious and glaring defects in style, matter, and arrangement can render us insensible—will hail with pleasure the appearance of this latest production of his ever lively pen and amusing pencil. We cannot but think that in this, his second venture, the author has greatly profited by some of the severe but not unfriendly criticisms which were elicited by the publication of his first work. Mr. Campbell has, in "My Circular Notes," avoided the grave mistake of mingling together in wild confusion humorously-written notes of travel and sober arguments on difficult scientific questions; and he has exercised, as we think, a very wise discretion in relegating to an appendix the discussion of that important geological problem, the hope of solving which seems to have been his main incitement to undertaking this journey round the world. In perusing this scientific portion of his book, with which of course the readers of NATURE are principally concerned, we are happy to find far fewer examples of that looseness and inaccuracy of language and to miss that dogmatic tone and redundancy of illustration which were the conspicuous blemishes of the author's earlier work. And all these improvements have we think been effected, without any sacrifice of his really graphic and vigorous style of writing upon scientific questions.

Before proceeding to notice the purely scientific portion of "My Circular Notes," we must remark that, even those who care nothing about the geological problems discussed in it, will find very much to interest them in this most lively and amusing record of travels. Those who would realise the curious scenes which may be witnessed in the Western States of North America, where the most volatile elements of old nationalities are uniting to form a new community—those who take interest in that wonderful social experiment which is now being tried in Japan, no less a one than the transplanting, bodily, of the full-grown civilisation of the West among the most conservative races of the East—and those who desire to learn something of the relics of the ancient nations, languages, folk-lore, and creeds of Ceylon—cannot do better than accept the guidance of Mr. Campbell. In him they will find a most vivacious and ever-amusing companion. Yet, on the other hand, his digressions upon such subjects as emigration and the struggle of races, and his treatment of questions like the relationships of languages and the origin of myths, will sufficiently prove that he has thought earnestly upon many social and philological problems, and has aimed at something higher than merely writing a diverting book of travel.

In adopting the method of loosely stringing together extracts from his journal with private letters, and making no attempt to weld them into a consecutive narrative, our author certainly trespasses somewhat upon the indulgence of his readers. This disadvantage is perhaps in some degree compensated for, however, by the freshness and vigour of his descriptions and reflections, appearing as they do, just as at first dashed off in the presence of the strange scenes which inspired them.

The problem on which the author of this work has sought to throw light in making this journey round the world is one of considerable interest to geologists at the present time. In 1840 Agassiz brought forward evidence which soon convinced even the most sceptical that, not only did the glaciers of the Alps at one time extend far beyond their present limits, but that many districts—such as parts of our own islands, for example—which are now entirely devoid of glaciers, must once have been subjected to the powerful erosive action of moving ice. The idea was at once taken up by Buckland, Lyell, and other observers in this country, who showed that the new "Glacial theory" afforded a complete solution of what had hitherto constituted some of the most difficult and perplexing problems of geology.

By some later authors, however, the "Glacial theory," which had soon met with all but universal acceptance, was pushed far beyond those limits which geological observation warranted. It was asserted that, not only did the existing rock-surfaces of the more northern regions of the earth owe some of their later touches to the erosive action of glaciers, but that many even of the grandest valleys and the deepest lakes were entirely scooped out by their agency. Some even went farther than this, and declared that the whole region around either of the poles must at one period have been enveloped by continuous sheets of solid ice ("ice-caps") which extended far into temperate and even tropical latitudes. They maintained, in opposition to the arguments of Lyell, that no changes in the distribution of land and water on the earth's surface could possibly account for the former extension of glaciers, and they invoked the aid of some astronomical cause to account for the alleged phenomena. A few waxed even bolder than this, and insisted that they had found evidence, which warranted them in believing in the regular recurrence, during past geological time, of alternating mild and glacial periods; and several rival astronomical theories were even suggested to account for these supposed rhythmical changes in climate.

Among the foremost of the champions of these extreme views appeared the author of the present volumes. In 1873, he read before the Geological Society a paper in which he attributed the production of the whole valley system of Ireland to the erosive action of a polar ice-sheet. The remarks elicited from several geologists during the discussion of this paper appear to have induced Mr. Campbell, who, during his travels in Scotland, Norway, Iceland, North America, &c., had acquired great skill in recognising the peculiar marks produced by glacial action, to extend the limits of his observations by a journey right round the continent of Europe. What he then saw led him so far to distrust his former conclusions concerning the existence of a universal glacial period and a polar ice-sheet, that he determined to put the question to the severest test possible, by a complete tour of the globe.

Mr. Campbell's mode of arguing this question is as

follows:—At the present time glaciers enter the sea, within the northern hemisphere, down to the latitude of 60°; the sea is frozen and ice-marks are produced on the shore as far south as 40°; and icebergs drop their rocky burdens within 37° degrees of the equator. If there ever prevailed a universal glacial period with a general reduction in the temperature of the whole northern hemisphere, we ought to find traces of glacial action everywhere round the whole globe and extending even to more southern latitudes than 37°. If the ice-cap "ever existed, the marks of it ought to be found on all meridians alike. If ever there was a glacial period in our world, glacial marks ought to be found everywhere, in the same latitudes and at the same levels, in the same state of preservation."

Keeping these premises constantly before his mind, our author found, during his journey of eleven months, quite sufficient evidence to cause him to make a full retraction of his former conclusions on the subject. As far as Chicago he observed everywhere the most striking traces of former glacial action; but in the same latitudes to the westward he found these marks of old glaciers entirely disappearing; and although some signs of glacial action were detected in the Rocky Mountains themselves, yet from this great range onwards to Ceylon they were found to be wholly wanting. Mr. Campbell's previous expedition in eastern Europe had led him to conclusions as to the *local* character of glacial action which were quite in harmony with those obtained in this journey round the globe, and he enunciates the results of his latest observations upon the subject as follows:—"Whether I take marks which can be explained by glacial erosion, such as firths, valleys, lakes, &c., or marks which clearly are not glacial, such as peaks and canons, I find nothing to suggest a general glacial period in America or in Europe;" and he further proceeds to state that he can find no evidence whatever of a recurrence of universal glacial periods such as might result from the action of some astronomical cause.

We have already extended this notice of Mr. Campbell's valuable work to the farthest limits, and must refer to the book itself for the details of the evidence on which his conclusions are founded.

In bringing our remarks to a close, we may add that the author's present views on the influence produced on climate by the changes of level in different districts, resulting in alterations in the direction of ocean currents, &c., appear to be quite in harmony with those so long and firmly maintained by Lyell, in opposition to the cosmical theories of the extreme glacialists. His observations on Western North America are fully confirmed by the more detailed examination of the districts by several of the United States' geologists; and his conclusion that there is no evidence of the former existence of a general "Glacial period" are quite in accordance with those enunciated by Dr. Hector and other observers who have studied the glaciers of the southern hemisphere. Prof. Nordenskjöld has, moreover, shown how completely palæontological evidence of the clearest character disposes of the notion of frequently recurring glacial epochs in past geological times.

We cannot but admire the candour with which Mr. Campbell renounces his previously-expressed opinions; and we may, perhaps, be allowed to express a hope that the facts and arguments which have led him to so greatly modify his views on glacial phenomena, will not be without effect on the minds of others, who, like him, have certainly pushed their conclusions derived from a study of very limited portions of the earth's surface, to generalisations far beyond what those observations can be legitimately made to support.

J. W. J.

SCLATER'S "GEOGRAPHICAL ZOOLOGY"

On the Present State of our Knowledge of Geographical Zoology. By P. L. Sclater, M.A., F.R.S. Being the Presidential Address delivered to the Biological Section of the British Association. (London, Printed by Taylor and Francis: 1875.)

WE have received a copy of Mr. Sclater's address as President of the Biological Section of the British Association, at its meeting last year, at Bristol. At the time when it was delivered we had the opportunity of presenting it in full to our readers (*vide* NATURE, vol. xii. p. 374, *et. seq.*). In the independent form now under notice it has added to it a most important appendix, namely, a list of all the works and memoirs referred to in its various sections. When we say that these are more than 420 in number, a fair estimate may be formed of the labour which must have been involved in their collection and classification. Exact references are a most valuable aid to biological research, and prevent the waste of much time during special investigations, and on the subject of the geographical distribution of vertebrated animals, this address of Mr. Sclater's supplies all that can be wanted by anyone either reviewing the subject as a whole, or desiring to obtain the best information on the zoology of any special locality.

The arrangement adopted is regional, the basis being the universally accepted divisions proposed by Mr. Sclater himself. They are thus tabulated:—

I.—Palæarctic Region	
II.—Ethiopian Region	
II*a*.—Lemurian Sub-region	*Arctogaea.*
III.—Indian Region	
IV.—Nearctic Region	
V.—Neotropical Region	*Dendrogaea.*
V*a*.—Antillean Region	
VI.—Australian Region	*Antarctogaea.*
VII.—Pacific Region	*Ornithogaea.*

Each of these regions is divided into sub-regions, which are described separately. Perhaps no better idea can be formed of the extent to which the greater divisions of the globe have been studied, than by a comparison of the number of works and memoirs which have appeared with reference to each, or to parts of each. As might be premised, there has been much written on the animals of the Palæarctic region, considering that it includes Europe, together with North Africa, Siberia, and North China. There are 119 references with regard to it, the most recent including Prof. Lilljeborg's work on the Mammals of Sweden and Norway, Mr. Dresser's "Birds of Europe," Mr. J. Hancock's "Birds of Northumberland and Durham," Dr. Schreiber's "Herpetologia Europaea," the German translation of Dr. N. Severzow's work on the Birds of Turkestan, the late Dr. Stoliczka's "Avifauna of Kashgar in Winter," Lieut.-Colonel Irby's "Ornithology of the Straits of Gibraltar," and the new edition of Bell's "British Quadrupeds."

With respect to the Ethiopian region—the field-work of Sir Andrew Smith, Livingstone, and Du Chaillu—46 are mentioned, and 40 on the Indian region, which has been so much investigated by those who, from other reasons, have had to take up their residence in our Eastern empire. There are 25 works referred to respecting the Nearctic region, and as many as 138 on the Neotropical, which demonstrates how rich a field South America has proved to the students of biology, it being remembered that Mr. Darwin himself obtained the bulk of his practical experience of animal life in that continent. Forty-one works on the Australian and nine on the Pacific region include the remainder of the list. Mr. Sharpe's edition of Layard's "Birds of South Africa," Mr. Hume's "Stray Feathers," Lord Walden's Memoirs on the Birds of Celebes and the Philippines, Mr. Scammon's "Marine Mammals of the North-Western Coast of North America," Messrs. Baird, Brewer, and Ridgway's "History of North American Birds," Dr. E. Coues' "Birds of the North-West," Prof. T. R. Jones' "Manual of the Natural History, Geology, and Physics of Greenland," Messrs. Sclater and Salvin's "Nomenclator Avium Neotropicalium," Mr. A. W. Scott's "Elementary Treatise on the Mammals of New South Wales," the late Mr. J. Brenchley's "Cruise of the *Curaçoa*," Dr. Buller's "Birds of New Zealand," being the most important works which have appeared during the last two or three years, on the regions other than the Palæarctic, above referred to.

That several works have appeared since Mr. Sclater's address was delivered—including, among the most important, the late Mr. Blyth's "Catalogue of the Mammals and Birds of Burmah," edited by Dr. J. Anderson, Dr. Dobson, Lord Walden, and Mr. Grote, a special notice of which we hope very shortly to give—and that Mr. Wallace's important two volumes on the "Geographical Distribution of Animals" may be expected very soon, shows how much stress is now being laid on the fauna of different regions, and adds further to the importance and value of the encyclopædic address, the contents of which we have brought before the notice of our readers on the present occasion.

OUR BOOK SHELF

An Elementary Treatise on Curve Tracing. By Percival Frost, M.A. (London: Macmillan and Co., 1872.)

On the Transcendental Curve whose Equation is—

$$\sin y \sin my = a \sin x \sin nx + b.$$

By H. A. Newton and A. W. Phillips. (From the *Transactions of the Connecticut Academy*, vol. iii., 1875.)

MR. FROST'S work is an elementary one, inasmuch as no advanced acquaintance with the differential and integral calculus is required; nor do his methods turn upon the higher algebra, nor upon the science of projections. Indeed he is careful to restrict himself for the most part to fairly elementary processes. It is not a complete treatise, as he does not touch upon roulettes or upon curves, given by intrinsic equations. These latter curves have been, as is well known, discussed and fully illustrated in the late Dr. Whewell's two memoirs in the *Cambridge Philosophical Transactions* (vols. viii. and ix.) We miss, too, all account of curves of historical interest. Occasional notices of these have been given by different writers, but we should like a sketch of them drawn up by some competent hand, with an account of their origin and applications.

Reasons have weighed with Mr. Frost in making these omissions, and we do not grumble at his taking his own line in his treatment of the subject as he has given us a full treatise, abundantly illustrated by figures, of curves, ranging from simplicity to considerable complexity of form. The preface is an interesting one (though by the way, the author was rather unwilling to write it), and in it attention is called to the fact, among other reasons, why junior students should devote some little time to curve-tracing, that the subject of graphical calculation is coming more into use, being applied to problems in statics (see Culmann's "Graphische Statik"), engineering, and crystallography.

We cannot here give any detailed sketch of the contents of the work, further than to draw attention to the last chapter, which treats of the inverse problem, viz., given the form of a curve to investigate its equation, or an approximation to it. We do not remember to have seen the attempt made elsewhere. Should the subject be taken up and carried on with success, we may look for the equation to one's name taking the place of the name on an address card.

The majority of the curves discussed and traced in Mr. Frost's book are algebraical ones.

Messrs. Newton and Phillips write that from the form of a transcendental curve it is not easy to state the equation that will represent it. So instead of taking up the inverse problem, they have selected from out of the host of transcendental equations, and exhibit twenty-four pages of plates of the plane curves furnished by assigning different values to the constant quantities a, b, m, and n in the equation given above.

These forms, as might be imagined, are all symmetrical, and much resemble carpet patterns. The tract is an interesting evidence of the patience and skill at draughtsmanship of the authors.

Kurzes Chemisches Handwörterbuch zum Gebrauche für Chemiker, Techniker, Aerzte, Pharmaceuten, Landwirthe, Lehrer, und für Freunde der Naturwissenschaft überhaupt. Bearbeitet von Dr. Otto Dammer. (Berlin: Robert Oppenheim, 1876.)

TO keep pace with the rapid growth of chemical science would be almost a hopeless task, were it not for the literary organisation and classification undertaken from time to time by such writers as the author of Watts's "Dictionary of Chemistry," and Dr. Dammer, the compiler of the present volume. To writers of this class who take upon themselves the laborious drudgery of "stock-taking," workers in the ranks of science owe a debt of gratitude which cannot be too highly estimated.

In coupling together the names of Mr. Watts and Dr. Dammer, it is by no means our intention to imply any similarity between the respective "dictionaries." Dr. Dammer's work is perhaps more truly a dictionary in the proper signification of the term than Mr. Watts's seven volumes, for while the latter contain full, and in many cases, exhaustive information on the various subjects treated of, the whole of the former is comprised in one volume royal octavo, of some eight hundred pages. The justly esteemed "dictionary" of English chemists need fear, therefore, no rival in the present volume, the two works rather bearing to each other the relationship of a chemical encyclopædia to a glossary of chemical terms.

The longest articles in the present volume are those on absorption, equivalents, alum, ammonia, aniline, aromatic bodies, ashes, animal respiration, atmosphere, atom, base, benzoic acid, benzene, succinic acid, beer, blood, soils, bread, chemistry, chromic acid, steam, diffusion, albumin, electricity, petroleum, nutrition of plants and of animals, acetic acid, acetates, colouring matters, fats, flesh, galvanic batteries, gases, tan, glass, coal, hydrocarbons, madder, crystal, copper, illuminating gas, solution, magnetism, metals, metalloids, microscope,

milk, mortar, nickel, photography, analysis (qualitative and quantitative), nitric acid, nitrates, salts, oxygen, gunpowder, sulphur, sulphuric acid, silver, specific gravity, thermometer, porcelain, hyposulphites, water, wine, tartrates, tungstates, sugar, &c. The following subjects are treated of in some detail:—Alcoholometry, aniline dyes, areometer, iron, carbonates, light, mineral waters, common salt, sulphates, heat.

The value of the dictionary as a work of reference is decidedly enhanced by the adoption of thick type for the words heading the articles. In the case of recently discovered compounds we are of opinion that a short bibliographical reference to the paper wherein such compounds are first made known would have greatly increased the value of the articles without materially adding to their length. The author has fallen into an error in treating of thermo- and pyro-electricity under the same heading; the former term is employed by electricians in this country to denote the electricity developed by heat in *conductors*, the latter to denote the electricity produced by heat in *non-conductors*.

Bearing in mind the enormous range of subjects now embraced by the science of chemistry, for a volume of the present size the amount of information conveyed is really very great. With the exception above pointed out, the articles, though necessarily brief, are to be depended on for accuracy, and we can safely recommend Dr. Dammer's dictionary as a useful work of reference.

R. M.

Clouds in the East. Travels and Adventures on the Perso-Turkoman Frontier. By Valentine Baker. With Maps and Illustrations. (London: Chatto and Windus, 1876.)

THE author of this interesting volume had special facilities for visiting the Russian outposts in Asia and the Persian frontier; he had powerful recommendations to the highest Russian and Persian authorities. By various causes, however, he was prevented from taking complete advantage of these, so that the main part of his work describes his journeys in the district to the south of the Caspian, and from Teheran towards the north-east Persian frontier. He reached the Caspian by Trebizond and Tiflis, and gives some interesting particulars as to navigation on the inland sea. He was able to visit the mouth of the much-talked-of Attrek, and found that the Gurgan, to the south of the Attrek, is the real Russian frontier in this region. He was unfortunately prevented from visiting Merv and Herat, which he had intended to do. Mr. Baker's main objects were sport and to ascertain the real nature of the advances made by Russia in Central Asia. Of the former he got a fair amount around Teheran, and his work will be of very considerable importance to those who are interested in the movements of Russia. He took considerable pains to ascertain Persian feeling on the question; Persia cannot understand, or rather misunderstands, England's inaction. Mr. Baker gives many valuable notes as to the nature of the country passed over, its productions, antiquities, and inhabitants. Concerning the Turkomans especially, and their wonderful houses, many details will be found. Altogether the work is an intelligent and interesting narrative of travel in an important region, and a substantial contribution to the Asian question. There are three good maps, but the chromolithographs are very poor specimens of their kind.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

The Use of the Words "Weight" and "Mass"

I WILL supplement Mr. Bottomley's authorities for the meaning of *gravity* by others which will be perhaps considered more relevant. Maupertuis, "Figure de la Terre," Paris, 1738, writes:—"Il faut bien distinguer ici la pesanteur d'un corps d'avec son poids . . . La pesanteur dans un grand corps, n'est pas plus grande que dans un petit. Il n'en est pas ainsi du poids; il dépend non-seulement de la pesanteur, mais encore de la masse des corps . . . il est le produit de la pesanteur par la masse" (p. 155). Subsequently, he lays down the distinction between pesanteur and gravité which Clairaut adopted; but universally the English *gravity* has been used as synonymous with the French *pesanteur*. Airy, "Gravitation," p. 3: "To take the ordinary force of gravity for an instance, we might measure it by the pressure which is produced on the hand . . . or by the number of inches through which the lump of lead would fall in a second of time . . . But there is this difference between the two measures; if we adopted the first . . . we should find a different measure by the use of every different piece of lead; whereas if we adopt the second . . . we shall get the same measure for gravity whatever body we suppose subject to its influence." Here the broad distinction between "weight" and "gravity" is clearly laid down; the one is the "impressed force" on the falling body, the other its "accelerative effect" (Thomson and Tait, "Treatise on Nat. Phil.," 217–219), or the more familiar "moving force" and "accelerating force." In the "Treatise" the former is called the "force of gravity on the mass of a body," 220; but "gravity" alone seems clearly enough defined as acceleration, by the words "According to this formula, therefore, polar gravity will be

$$g = 32{\cdot}088 \times 1{\cdot}005133 = 32{\cdot}2527."$$

Again, § 226: "The augmentation of gravity per degree . . . is, at most . . . The average . . . differs certainly, but little from 32·2."

I think it evident that *gravity* has *not* been "lying ready for use, but left almost idle," as Mr. Bottomley supposes.

To the restriction on the use of weight—which I feebly support, but which is certainly not mine—I do not conceive that the "Act of Parliament" offers any bar; as the weights of masses are merely thereby defined in terms of the weight of the standard mass. This restricted sense is clearly recognised in such passages as the following, from Thomson and Tait's "Elements," § 366, "The measurement of force whether in terms of the weight of a stated mass in a stated locality . . ."

As to the compounds "*centivires*," &c., I advisedly adopted the Latin prefixes in their old etymological sense, so as to have wholly Latin names and thereby prevent any confusion with the C. G. S. kinetic measures. The employment in the metric system being quite conventional and contrary to analogy, I feel justified in following older precedents.

J. J. WALKER

"The Recent Origin of Man"

IN NATURE, vol. xiii. p. 245, a writer over the initials "W. B. D." reviews in no very complimentary terms my book entitled "The Recent Origin of Man." I am charged with inconsistency, inaccuracy, incompetency, &c. When charges of this sort are made they ought not to be made lightly, and the writer making them ought to weigh his statements.

My space is necessarily brief, but I beg permission to comment on a few of the assertions made by "W. B. D." in rendering his judgment on the premises.

1. He remarks: "The statement that no traces of a rude and imperfect civilisation have been met with in the East is refuted by the discovery of enormous quantities of flint implements in Egypt and of neolithic axes in Asia Minor and in India. In the river gravels of both these regions paleolithic *hâches* have been found of the same type as those of Amiens and Abbeville."

We all know that palæolithic implements have been found in the river-gravels of India; I refer to this on p. 31 of my book; but I am not aware that palæolithic implements have been found in the river-gravels of Egypt or Asia Minor. As "W. B. D." asserts it, I beg leave to ask for the particulars.

As for the occurrence of flint implements in Egypt, I remark on p. 478: "Flint implements have been found in Egypt but they belong to the Neolithic age, and occur on the surface, or near the surface, or in the tombs." I mention that one implement of palæolithic type had been found. I show that flint arrow heads and flint knives have been frequently found in the Egyptian tombs by the side of the mummies.

That Sir John Lubbock found in the Nile valley a few implements resembling the palæolithic types I am aware; but implements of palæolithic type were found at Cissbury by Col. A.

Lane-Fox. *No flint implements have been found in Egypt in association with an extinct fauna, or in beds corresponding in geological position to the implement-bearing gravels of the Somme valley.*

2. "W. B. D." asserts that in every one of the cases cited by me (I cite one or two hundred) to prove "the ages" simultaneous, "there is no proof that the deposit has not been disturbed."

I select by way of reply five examples: the pile-village at Unter Uhldingen (Switzerland); the skeletons found at Cumarola, in Italy; the trenches at Alise; the pile-village near Lubtow, in Pomerania; and the relic-beds at Hissarlik.

3. Solutré is a crucial case. Referring to this, "W. B. D." dioposes of it by remarking that a Merovingian cemetery was planted here on a palæolithic station, "as he was informed by Dr. Broca at the French Association at Lyons in 1873." "In this case," he proceeds, "which is made the basis of the attack on the high antiquity of palæolithic men, the human skulls are comparatively modern, and the refuse heap of an untold age."

This statement implies both ignorance and a treacherous memory on the part of "W. B. D."

We are all aware that there are Merovingian remains at Solutré. There are also Roman or Gallo-Roman remains. But the argument from Solutré is this: (1) That the bones of the extinct animals found in association with the flint implements have preserved a portion of their gelatine, and that the horns of the reindeer, when cut, yield the odour of fresh horn. (2) That the flint implements found, though unpolished, are of very superior and advanced workmanship, hardly inferior to the beautiful specimens from Denmark. (3) That there are found here the remains of some 40,000 horses, and that the horse was probably domesticated. (4) That there are numerous instruments here of palæolithic date, some of them in carefully closed stone cists or boxes. The remark of "W. B. D." about the Merovingian graves has therefore no application except in connection with (3) and (4); as regards (3), the *horse-deposit*, as it is called (outside of the refuse-heaps), some of which was compacted into a solidified mass—contained the flint implements and the bones of the mammoth, reindeer, &c.; and, in addition, *extended beneath* the most ancient fire-places, or hearths, containing the palæolithic skeletons and the flints and the bones of the reindeer and mammoth. The horse-remains are not, therefore, Merovingian. As regards (4), and the assertion, on the authority of Dr. Broca, that the graves are Merovingian; this whole subject came up at the French Association at Lyons in 1873; the Association *visited* Solutré; and by way of reply to what "W. B. D." says he gathered from Dr. Broca, I quote from the report of the Proceedings of the Association in "Matériaux pour l'Histoire de l'Homme," 7e, 8e, and 9e Livraisons, 1873, pp. 324, 325, 342. When M. Cartailhac observed that "the discussion was of the greatest gravity, and would remain celebrated in the history of anthropological science," and that although there may have been some disturbances of the soil, "one thing remained certain, viz., that in more than ten instances, a human skeleton had been found on a quaternary fire-place, and not one fact exists to be opposed to the admission of their contemporaneity"—when M. Cartailhac had expressed himself to this effect, the report proceeds:—

"M. Broca partage cette opinion et déclare ouverte la discussion sur le deuxième problème: *les chevaux.*"

Subsequently, participating further in the discussion (p. 342), M. Broca stated that he had examined twenty-five skulls from Solutré, and that of this number seventeen belonged to the epoch of the reindeer—"à la véritable époque paléolithique solutréenne."

I leave "W. B. D." to reconcile these declarations of Dr. Broca made in the public meeting with the private declarations made to him. "W. B. D." closes with the remark that "he has not been able to find [in the book] a single shred of proof of the recent origin of man."

I show that the lake-dwellings in France come down to the eighth century of our era; in Pomerania and Sweden to the eleventh century. I show that great changes of level have occurred in different parts of the earth within a comparatively recent period, as at Uddenalla and Södutalje in Sweden, and in the island of Möen.

I show that in America the remains of the mastodon and mammoth occur in the most superficial deposits—the food sometimes preserved in the stomach; I refer to the preservation of the Mammoth in Siberia; I show that the reindeer and Great Irish Elk lived in Europe down to the Middle Ages; that the Cave-bear survived to Neolithic times, &c. I show that the hippopotamus is figured in the Trojan bed at Hissarlik; that the lion was found in Europe three centuries before our era; that the rhinoceros is found in the neolithic caverns of Gibraltar; that the elephant was brought to Shalmaneser II. by the *Muzri* in the eighth century B.C. I might have added *that the elephant lived in Mauritania (near the Straits of Gibraltar) in the time of Herodotus and Pliny.*

I point out that, owing to the continuance of the ice-sheet, palæolithic man never penetrated into Scotland or Denmark; but that the human period there commences with the Neolithic age, which, interpreted, means that *the Glacial epoch in that region lasted down to the date of the older lake-dwellings.*[1]

JAMES C. SOUTHALL

Richmond, Virginia, U.S., March 20

"The Unseen Universe"

IN Art. 213 the distinguished authors of "The Unseen Universe" say: "We have already shown (Art. 164) that development without life, that is dead development, does not tend to produce uniformity of structure in the products which it gives rise to."

In the article referred to they say: "There is one peculiarity of the process of development now described which we beg our readers to note. We have supposed the visible universe, after its production, to have been left to its own laws, that is to say, to certain inorganic agencies, which we call forces, in virtue of which its development took place. At the very first there may have been only one kind of primordial atom; or, to use another expression, perfect simplicity of material.

"As, however, the various atoms approached each other in virtue of the forces with which they were endowed, other and more complicated structures took the place of the perfectly simple primordial stuff. Various molecules were produced at various temperatures, and these ultimately came together to produce globes or worlds, some of them comparatively small, others very large. Thus the progress is from the regular to the irregular." Is not this a *non sequiter?* "And we find a similar progress when we consider the inorganic development of our own world. The action of water rounds pebbles, but it rounds them irregularly; it produces soil, but the soil is irregular in the size of its grains, and variable in constitution. Wherever what may be termed the brute forces of nature are left to themselves, this is always the result; not so, however, where organisms are concerned in the development.

"Two living things in the same family are more like each other than two grains of sand or two particles of soil. The eggs of birds of the same family, the similar feathers of similar birds, the ants from the same ant-hill, have all a very strong likeness to each other." It seems to me that the argument here tends to show that the planetary or world development, and what the authors term living development, are based on the same primordial law. If development without life does not tend to produce uniformity of structure in the products it gives rise to, and development with life does tend to the opposite result it would logically follow that the worlds with which we are acquainted are the result of living development.

No two living things of the same family are more alike than are the planets of our solar system; alike in form, alike in their motions, and alike in the material of which they are made; and if the doctrine of their growth, maturity, and final dissolution which the nebular hypothesis ascribes to them, be a verity, the alike in these respects to living development on the earth. have long been of the opinion that the same principle underlie all development from the smallest microscopic insect to the largest world in the universe, and I am gratified to find two such profound philosophers as Professors Stewart and Tait virtually advancing the same theory. It may, however, be said that they do not admit this sequence. They suppose the visible universe, after its production, to have been left to its own laws, to certain inorganic agencies or forces in virtue of which its developments took place, that at first there may have been only one kind o primordial atom from which all present development has arisen. This is mere speculation; but admitting its verity, it does not alter the truths enunciated by them that dead development does not tend to produce similarity of structure, that the results of the brute forces of nature left to themselves are accidental forms, and that where there is uniformity of structure there is living development.

[1] Certainly not 10,000 years ago; in my opinion not 3,500.

In a careful examination, however, of the whole argument of the authors of the "Unseen Universe," it looks to me as though they saw clearly to what their course of reasoning, as far as this particular point is concerned, tended, but were willing to stop short of the true logical result, believing that humanity was not yet prepared to admit that we are only a small part of one stupendous whole, a universe of individual life.

Of the main object and scope of their argument I have nothing to say, only this: if the premises assumed—and they are the assumptions of the modern school of science—are correct, there is nothing unreasonable in the conclusions at which the authors have arrived.

NOTE.—Since writing the above I have seen the authors' preface to the second edition of the "Unseen Universe," in which they say: "To reduce matters to order, we may confidently assert that the only reasonable and defensive alternative to our hypothesis (or, at least, something similar to it) is the stupendous pair of assumptions that visible matter is *eternal*, and that IT IS ALIVE. If anyone can be found to uphold notions like these (from a scientific point of view), we shall be happy to enter the lists with him." If the distinguished authors will confine themselves to this proposition, that "All visible aggregations of matter, such as our earth and its congeners, are living organisations, in other words, ARE ALIVE," I think the affirmative can be successfully maintained.

Whether matter is eternal and each individual particle or atom of matter is alive, is too far in the interior of the unknowable to be discussed with any possibility of successful results, and, too, the idea of an atom being a living organisation is directly opposed to the whole theory of atomicity, and scientifically ludicrous in view of that theory. JOSIAH EMERY

City of Williamsport, Pa., U.S., March 10

Prof. Tait on the Earth's Age

IT is well known that Sir W. Thomson has concluded, from different lines of argument, that the age of the earth, as a body cool enough for habitation, cannot be much greater than a hundred million years.

Prof. Tait, in his "Recent Advances in Physical Science," recapitulates these arguments, but with a different conclusion. He states the limit of age to be about *ten* million years.

As the subject is of immense interest, may I ask Prof. Tait to explain this change of conclusion? J. D. EVERETT

A Relapsed Donkey

SOME years ago on one of the Lucknow roads I met a "Dhobi" (washerman) with some donkeys. I send you a picture of one of them, made by a native artist. It shows, I think, the relationship between the zebra and the donkey better than many which I have seen. Mules and horses often show zebra marks on their legs, but I have never before or since seen the marks so well displayed on the trunk and legs as in this donkey. The stripes on the body are blended together at their base, and so are the stripes on the legs blended into *bands*. At the time I endeavoured to find out whether in the days of the kings of Oudh there had been any zebra in Lucknow which might have bred with donkeys, but could find nothing about it. Had there been a zebra which bred with donkeys, I think there would have been more of these striped animals; but this is the only one I have seen since 1858. I think it a case of simple *atavism*. Perhaps you may think it worthy of a record in NATURE. All "Dhobis" donkeys are small, wretched creatures, mostly with crooked legs. E. BONAVIA

Lucknow, Feb. 29

OUR ASTRONOMICAL COLUMN

VARIABLE STARS.—Mr. J. E. Gore, M.R.I.A., of Umballa, Punjab, calls attention to a star of the sixth magnitude entered in Harding's Atlas, between ϵ Leporis and B.A.C. 1553, and which is underlined. Mr. Gore says: "In February of this year, with a 3-inch refractor, I found Harding's 6 m. star a little brighter than the 9 m. star south of it, but less than several 8 m. stars (Harding) *following*. It has a small companion f at about $1' \pm$. Harding's 9 m. stars seem about 10 m." Reading off from the Atlas the position of the sixth magnitude for 1800 appears to have been about R.A. 73° 32'·5, N.P.D. 111° 25', whence for 1876·0 we have R.A. 4h. 57m. 25s., N.P.D. 111° 18'. This star does not occur in Argelander's Zones, nor in the Washington Zones in the volumes of observations for 1870 and 1871.

Gilliss has this note to No. 543 of his Catalogue of 1248 stars for 1840 (B.A.C. 3815): "Probably variable at very short intervals. Of the seven observations three estimations make it 6th magnitude, three 5th, and the other 5·6." This star, which was observed by Flamsteed, Bradley, Piazzi, and Taylor, was also observed by Argelander on three nights, viz., 1850, March 15, 1851, April 22 and 28, the magnitudes being noted on these occasions, 5, 7, 6 respectively. It appears not unlikely that if this star is examined at short intervals Gilliss's suspicion of variability will be confirmed. It is situate in Hydra R.A. (1876), 11h. 2m. 45s., N.P.D. 117° 25'.

As perhaps connected with the subject of variable stars, we may refer to a remark by Piazzi, applying to his star XVI. 35. He says: "Fortiter micans, intereadem, sequens tranquilla luce splendescit." No. 35 is called 8 m., and the star following 15", and south 18", which did not exhibit the strong scintillation of its neighbour, 6 m. Both stars occur in the Washington Zone, 1847, June 17, magnitudes 7·8 and 6·7. Also to the remark attached by Lalande to the star of 8·9 mag. observed on the middle wire at 20h. 35m. 39·5s., 1796, August 23, "Beaucoup de scintillation" ("Histoire Céleste," p. 242); this star is No. 40102 Cygnus, of the reduced catalogue, R.A. (1876), 20h. 39m. 23s. N.P.D. 58° 45'·2. Several of the variable stars are well known to exhibit striking scintillation at times, and perhaps more especially when on the point of diminution; this has been particularly the case with S Virginiis (Hind, 1851), in which reddish-yellow star flashes of a deeper red are occasionally present, producing an impression of unusual scintillation.

The star Lalande 34746 Aquila is of a deep orange colour. Its position is erroneously given in the reduced catalogue from the observation 1796, June 25; the N.P.D. should be 96° 43' 28"·7. It does not occur in the Zones of Bessel or Santini. Lalande calls it 7m., and it is entered of the same magnitude in the charts of Capocci and Inghirami. In September, 1873, it was 7·8, so that at present a claim to be included in the list of variables is not quite made out; still as so large a proportion of the highly-coloured stars do prove to be variable, L. 34746 may be worth watching. Position for 1876·0. R.A., 18h. 38m. 2s., N.P.D., 96° 39'·5.

Several of the variable stars to which attention has been called in this column during the last twelvemonth, are now in favourable positions for observation.

THE SEARCH FOR COMETS.—No new telescopic comet has been detected since that found by M. Borrelly at Marseilles early in December 1874, an interval of more than sixteen months. Perhaps we may attribute this circumstance partly to the very unfavourable weather which has prevailed generally during the last year, but it is pretty certain that if a systematic search for these bodies, with suitable instruments, could be instituted by aid of amateurs of the southern hemisphere, cometary astronomy would be greatly the gainer. Such work is not adapted to the routine of the public observatories, nor can they afford, in the actual state of what may be termed the standard astronomy of the other hemisphere, to devote time to it; but it is an occupation especially within the province of the amateur. If his instrumental means are not equal to the determination of accurate positions, he may content himself with intimating any discovery to the astronomers in charge of the public establishments who, after receiving indication of the approximate position of any new comet, will no doubt secure observations sufficient for the calculation of the orbit. In this way it is highly probable that the number of known comets of short period may be materially increased, since it is only at certain returns

that conditions favourable to observation in the northern hemisphere occur. The "comet-seeker" properly so called is an instrument much better known on the continent, and probably in America, than in this country. It may be used for much other useful astronomical work, and if the observer is content to be without equatorial mounting, and rely upon star-maps for ascertaining approximate positions, a first-rate instrument of this class need not involve great outlay. It is true, we believe, that the fine comet-seekers of the kind produced by the continental opticians (those of Berlin and Vienna especially) have, like most other things, increased in their cost during the last twenty years or so, but less perfect instruments would doubtless enable an amateur to do excellent work in the above direction.

TO FIND EASTER

A NEW York correspondent sends us the following rule, which he states to be devised by himself, to find the date of Easter Sunday, perpetually :—

To find Easter "for ever."

Divide	By	And call the	
		Quotient	Remainder
The year of our Lord	19	—	a
" "	100	b	c
b...	4	d	e
$b + 8$	25	f	—
$b - f + 1$...	3	g	—
$19a + b - d - g + 15$	30	—	h
c...	4	i	k
$32 + 2e + 2i - h - k$	7	—	l
$a + 11h + 22l$	451	m	—
$h + l - 7m + 114$	31	n	o

n is the number of the month of the year and $o + 1$ is the number of the day of the month on which Easter falls.

PROF. FLOWER'S HUNTERIAN LECTURES ON THE RELATION OF EXTINCT TO EXISTING MAMMALIA [1]

VII.

THE *Carnivora*, as existing at the present day, form a natural group, though very sharply divided into two distinct sections, the Pinniped or aquatic, and the Fissiped or terrestrial forms. The former include the Seals, Walrus, and *Otariæ* or Sea-lions. They differ from the terrestrial carnivora chiefly in modifications of their limbs to suit a semi-aquatic life. In their dentition they also present striking distinctions. Though they have the small incisors, large, pointed, recurved canines, and more or less trenchant molars characteristic of the order ; the incisors depart from the typical number of three above and three below on each side, so constant in the other division, being always less numerous, and the molars are simple and uniform in character, never having one tooth differentiated as the sectorial, and others as tubercular molars. The walrus offers a most remarkable modification of dental organisation, which, being unaccompanied by any other deviation from the general structure of the group affords an important caution against placing too great reliance in classification upon characters derived from teeth alone. It must, however, be noted that a knowledge of the complete dentition of this animal in its early stages shows a nearer conformation to the general type than appears at first sight in an examination of the adult. The existing species of Pinnipedia show some gradational forms between the most aquatic species, and those (as the *Otariæ*) which more nearly resemble the terrestrial Carnivores, and upon the supposition that the former have been gradually differentiated from the latter, it might be hoped that palæontology would have revealed some further stages in the series of modifications. At present, however, this expectation has been disappointed. In fact, the fossil remains of seals and seal-like animals as yet known are not numerous or of very great interest, although when those of the Antwerp crags, where they occur more abundantly than elsewhere, have been completely described (a work upon which M. Van Beneden is at present engaged) we may look for further information about them. At present we know of fragments of skulls, jaws, and principally isolated teeth assigned to Pinnipeds, from various Miocene and Pliocene deposits in France, South Germany, Italy, and Bessarabia. The genus *Pristiphoca*, was founded by Gervais on a jaw found in the Pliocene marine sands of Montpellier ; it belongs to a form apparently allied to *Stenorhynchus* and *Pelagius*. The Miocene species from Aquitaine, known only by isolated teeth, are referred by Delfortrie to the genus *Otaria*. Tusks of animals of great size, and apparently allied to the walrus, have been found in the Antwerp and Suffolk crags, and received the name of *Trichechodon*, and a lower jaw of much interest, as showing a transitional character between the walrus and the more typical seals, also from Antwerp, has been described under the name of *Alachtherium*.

The fissiped carnivora are distinguished from the seals by their limbs being adapted to terrestrial progression, and by their dentition. The latter is best exemplified by that of the dog, which is one of the most average or generalised forms of the order. Its dental formula is $i\ \frac{3}{3}\ c\ \frac{1}{1}\ p\ \frac{4}{4}\ m\ \frac{2}{3} = 42$, thus only wanting the last upper molar to complete the full typical mammalian dentition. The premolar and molar series are much differentiated from each other in characters, and one tooth above and below is distinguished from all the others by its superior size and special attributes, and hence called in descriptive odontology the "sectorial" or "carnassial" tooth. Though the upper and lower "sectorial" have some adaptive similarity, and work against each other like the blades of shears, they are not the homologous teeth, the upper one being the fourth premolar and the lower one the first true molar. The former consists essentially of a more or less compressed blade, consisting of three cusps, and supported on two roots, and an inner lobe supported on a distinct root. The anterior lobe of the blade is very small, the middle one conical, high, and pointed, and the posterior has a compressed, straight, knife-like edge. The lower sectorial has two roots, supporting a crown, consisting, when fully developed of a compressed bilobed blade, a heel, and an inner tubercle. Great modifications in the characters of these teeth occur in the different genera of the sub-order, recent and extinct, but their essential similarity can be traced in all, though sometimes so disguised as to be recognised with difficulty. The teeth in front of sectorials in both jaws are compressed and pointed, those behind them broad and tuberculated.

The existing genus *Canis*, comprising the animals commonly known as dogs, wolves, jackals, and foxes, may be considered as truly cosmopolitan, being distributed on the American continent from Greenland to Patagonia, and throughout the Old World, and even Australia has its wild dog, though this may belong to a feral race, introduced originally by man. True dogs have also been found in a fossil state in Europe and North America, throughout the Pleistocene, Pliocene, and even Miocene periods. Many of these are only known by fragments and

[1] Abstract of a course of lectures delivered at the Royal College of Surgeons "On the Relation of Extinct to Existing Mammalia, with Special Reference to the Derivative Hypothesis," in conclusion of the course of 1873. (See Reports in NATURE for that year.) Continued from p. 450.

isolated teeth. In the early Miocene a very interesting form occurs, named *Amphicyon*, characterised by the greater development of the tubercular molars, which are not only larger relatively than in modern dogs, but the one missing in them is present, making the typical number complete. In addition to this generalisation in the dental characters, they possessed five toes on each foot, whereas the modern dogs have lost the hallux. They were large heavy-limbed animals, and have been supposed to present affinities to the bears, which, however, they only do inasmuch as they are more generalised carnivora than are the typical dogs. Remains have been found in various Miocene deposits in France, Germany, Italy, and some assigned to the same genus in North America. It is doubtful if the cynoid or dog-like type of carnivore was distinctly recognisable in the Eocene period, for the *Canis parisiensis* of the Paris gypsums was founded on a single tooth.

From the dogs, which hold a very central position in the order, the other existing members deviate in two different directions, one extending through the weasels and martens to the otters and bears, which make the nearest approach to the seals, and the other through the civets and hyænas to the cats, the most highly specialised and characteristic carnivores. The true bears are especially distinguished by the great development of the tubercular and the suppression of the sectorial portion of the molar series. The peculiar dentition of a bear is, for a carnivorous animal, highly specialised, and, as might be expected, appears to be a comparative recent introduction upon the earth, not extending beyond the Pliocene epoch, though several transitional forms occur, as *Arctotherium bonariensis* of South America, and *Hyænarctos sivalensis* of the Siwalik Mountain, and *H. insignis* of the Pliocene of Montpellier. Otters have been traced back to the Pliocene in France, and an allied form *Potamotherium*, to the Miocene. *Enhydriodon* is a large otter-like animal from the Siwalik Hills, with very broad and tuberculated molars. The evidence as to the ancient history of the *Mustelidæ* is not very satisfactory, as isolated teeth, by which many of the fossil forms are known, are not sufficient indications as to their general characters.

True *Viverridæ* are met with in the European Miocenes, one genus, *Ictitherium*, forming a transition to the Hyænas. The latter first appeared in the Upper Miocenes of Europe in forms intermediate between the extremes of existing species, and continued abundant until the close of the Pleistocene, but are now restricted to Africa and Asia. The species so common in the British caves appears to have been identical with the Spotted Hyæna (*H. crocæta*) of Africa, and the Striped Hyæna (*H. striata*), has been found fossil in France. The genus has not been met with in America.

The *Felidæ* present the most complete adaptive modification of the carnivorous type for a predatory existence. The jaws are short and wide, the incisors very small, the canines powerful, and the molar series shortened, and its sectorial element developed almost to the complete suppression of the tubercular portion. The limbs and claws have undergone corresponding specialisations. The family has now a very wide distribution, and has existed both in Europe and America since the Miocene period. It acquired one most remarkable modification in the animals known as *Machærodus* and *Drepanodon*, in which the upper canine was developed to an extraordinary degree, projecting down from out o the mouth like huge sabre-like tusks. In other respects the animal was constructed much on the ordinary feline type. They were widely distributed both in time and space, being found in North and South America, in Europe (including Britain), and in India, and ranging from Miocene to Pleistocene epochs, when they became quite extinct.

(*To be continued.*)

UNIVERSITY COLLEGE, BRISTOL

THIS college is now being incorporated under the Board of Trade as a company limited by guarantee, under the Companies' Acts, 1862 and 1867. The Board of Governors is the supreme governing body, and comprises all contributors above 5*l.*, and a large number of honorary members, with various qualifications, resident in various parts of the West of England. The Council is the managing body, consisting of sixteen, one-half of whom are elected by the governors (in the first instance by the contributors of money, about 20,000*l.* having been already promised in Bristol alone), and the other half are nominated by the Vice-Chancellors of the Universities of Oxford, Cambridge, and London, by the two contributing Oxford Colleges, by the Lord-President of the Privy Council, by the faculty of the old-established Bristol Medical School, and by the Principal and professors of the College.

The Council comprises the following names :—

Elected by the Contributors.—W. P. Baker, merchant; F. N. Budd, barrister; Rev. J. W. Caldicott, Head Master, Grammar School; Lewis Fry, School Board Chairman, solicitor; Rev. F. W. Gotch, Principal, Baptist College; Rev. J. Percival, Head Master, Clifton College; G. F. Schacht, pharmacist; W. Smith, merchant.

Prof. B. Jowett, nominated by Vice-Chancellor of Oxford; Prof. Stuart, nominated by Vice-Chancellor of Cambridge; W. L. Carpenter, nominated by Vice-Chancellor of London; Prof. Henry Smith, nominated by Balliol College; Rev. H. B. George, nominated by New College; R. W. Coe, nominated by Bristol Medical School.

At their preliminary meeting, held recently, the Council decided to commence operations in October next, and to appoint at first a Professor of Chemistry and a Professor of Modern History and Literature.

A piece of land has already been secured, but, for the first session or more, the lectures will be given in temporary premises. In all except the strictly medical classes of the medical school (which is being affiliated with the New College), the instruction will be open to young people of both sexes. Other courses of occasional lectures will be organised during the session.

In addition to the aid afforded by Balliol and New Colleges, Oxford, the Worshipful Company of Clothworkers in London have spontaneously offered a very handsome subvention to the College, with the view of establishing a department of Textile Industries for the improvement of the technical education of the West of England cloth manufacturing districts, as Stroud, Trowbridge, &c. It is believed that special attention will be given to the chemistry of dyeing and wool scouring, as well as to the mechanical part of the manufacture. The details of the arrangements are under the consideration of the Council and of a committee of cloth manufacturers and others, by whom very great interest is felt in the proposed scheme.

The registered temporary office of the College is Shannon Court, Bristol, and letters sent to the Secretary of University College, Bristol, at that address, will be attended to.

The Council are seeking for a permanent secretary, and offer a salary of 200*l.* per year. They hope to obtain the services of a gentleman who will throw himself with zeal and interest into the establishment of the College.

THE USE OF YELLOW GLASS FOR ZOOLOGICAL COLLECTIONS

AT a recent meeting of the Entomological Society of Belgium, M. Capronnier read a paper giving an account of some experiments which he had made bearing on the question as to how public collections of insects

may best be exhibited so as to satisfy all the purposes for which they are intended. M. Felix Plateau, at a former meeting, proposed to substitute yellow for colourless glass in lighting rooms containing entomological collections. In the discussion which followed it was suggested that experiments should be made by submitting insects to the influence of glasses of various colours. M. Capronnier was entrusted with carrying out these experiments, and the paper referred to contains his report.

Everyone knows that among the Lepidoptera it is the green and carmine colours which are most rapidly destroyed by daylight. M. Capronnier wished to obtain insects of the year's hatching, but could only obtain sufficient quantities of *Euchelia Jacobææ*, L. The inferior wings of this insect are of a deep carmine, uniform in tone, an important point in the experiments.

The principal colours of the solar spectrum are the yellow, the red, the blue. M. Capronnier rejected the red as giving a tint too dark, and added the mixed colours, violet and green. He had thus four tints chosen with the same degree of tone, and of a moderate shade—yellow, violet, green, and blue, besides a colourless glass. He made five small square boxes of ·08 centimetres square and one centimetre in depth; the whole surface was covered with one of the above-mentioned glasses.

Each wing was fixed in the middle of the box and floated in a bath of very bright light, but protected from the rays of the sun. Each of the wings was partly covered by a band of black paper, and their position was so arranged as to leave exposed successively each of the parts during a period of fifteen, thirty, and ninety days. The following are the results:—

Colourless glass.—After fifteen days of exposure the carmine tint was visibly attacked. After thirty days the alteration was more sensible, and after ninety days the work of destruction had rapidly advanced, and the carmine had passed into a yellowish tint.

Blue.—With this tint the same alterations took place as in the case of colourless glass.

Green.—This colour preserved the carmine during the first fifteen days; a change was indicated on the thirtieth day, and on the nintieth the alteration was marked.

Yellow.—During the ninety days the yellow alone left the carmine colour almost intact. M. Capronnier says *almost*, for a slight alteration in the tint could be noticed at the end of the ninety days. This last observation proves that there is no absolute preservative, and that collections must be kept in darkness, under penalty of seeing them seriously changed at the end of a given time.

Nevertheless, it is evident from the above that the yellow is the best preservative against alterations in the colours of insects. M. Capronnier consequently concludes that a yellowish colour should be preferred and combined in every arrangement of an entomological room. Moreover the cloths that cover the show-cases ought to be yellow rather than green, and what is important and indispensable, the window-blinds ought to be absolutely yellow.

RADIOMETERS[1]

DURING the discussion which followed the reading of Prof. Reynolds's and Dr. Schuster's papers at the last meeting of the Royal Society I mentioned an experiment bearing on the observations of Dr. Schuster. I have since tried this in a form; and as the results are very decided and appear calculated to throw light on many disputed points in the theory of these obscure actions, I venture to bring a description of the experiment, and to show the apparatus at work, before the Society.

I made use of a radiometer described in a paper communicated to the Society in January last. I quote the description from paragraph 184. "A large radiometer in a 4-inch bulb was made with ten arms, eight of them being of brass, and the other two being a long watch-spring magnet. The discs were of pith, blackened on one side. The power of the earth on the magnet is too great to allow the arms to be set in rotation unless a candle is brought near, but once started it will continue to revolve with the light some distance off."

This radiometer was floated in a vessel of water and four candles were placed round it, so as to set the arms in rotation. A mark was put on the glass envelope so as to enable a slight movement of rotation to be seen. The envelope turned very slowly a few degrees in one direction, then stopped and turned a few degrees the opposite way; finally it took up a uniform but excessively slow movement in the direction of the arms, but so slow that more than an hour would be occupied in one revolution.

A powerful magnet was now brought near the moving arms. They immediately stopped, and at the same time the glass envelope commenced to revolve in the opposite direction to that in which the arms had been revolving. The movement kept up as long as the candles were burning, and the speed was one revolution in two minutes.

The magnet was removed, the arms obeyed the force of radiation from the candles, and revolved rapidly, whilst the glass envelope quickly came to rest and then rotated very slowly the same way as the arms went.

The candles were blown out; and as soon as the whole instrument had come to rest, a bar-magnet was moved alternately from one side to the other of the radiometer, so as to cause the vanes to rotate as if they had been under the influence of a candle. The glass envelope moved with some rapidity (about one revolution in three minutes) in the direction the arms were moving. On reversing the direction of movement of the arms the glass envelope changed direction also.

These experiments show that the internal friction, either of the steel point on the glass socket, of the vanes against the residual air, or of both these causes combined, is considerable. Moving the vanes round by the exterior magnet carries the whole envelope round in opposition to the friction of the water against the glass.

As there is much discussion at present respecting the cause of these movements, and as some misunderstanding seems to prevail as to my own views on the theory of the repulsion resulting from radiation, I wish to take this opportunity of removing the impression that I hold opinions which are in antagonism to some strongly urged explanations of these actions. I have on five or six occasions specially stated that I wish to keep free from theories. During my four years' work on this subject I have accumulated a large fund of experimental observations, and these often enable me to see difficulties which could not be expected to occur to an investigator who has had but a limited experience with the working of one or two instruments.

[1] "On the Movement of the Glass Case of a Radiometer." By William Crookes, F.R.S., &c. Read at the Royal Society.

COMPRESSED AIR LOCOMOTIVE USED IN THE ST. GOTHARD TUNNEL WORKS[1]

THE boring of a tunnel of any importance presents difficulties of various kinds, among which may be mentioned the clearing away of the rubbish arising from the excavation of the gallery, whenever that reaches any considerable length, and the work is carried on with activity. Such were the conditions under which the boring of the Mont Cenis tunnel was carried on, and M. Fabre, the able contractor, has met with similar difficulties in the boring of the St. Gothard tunnel, now being carried out.

[1] From an article in *La Nature*, by M. C. M. Gariel.

The work was begun from two points, Airolo and Gœschenen, the two extremities of the future tunnel. The advance of the gallery, which is pushed on with activity, produces about 400 cubic metres of rubbish a day at each of the two faces of attack. To carry away this mass of rubbish, which is thrown regularly into trucks running on rails, it is impossible to employ locomotives, as the *cul de sac* nature of the galleries prevents

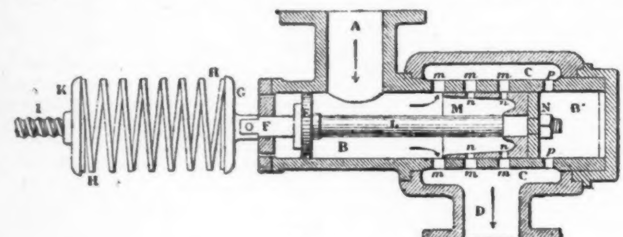

FIG. 1.

effectual ventilation. The high price of horses and the large number required prevent their use. The idea suggested itself of making use for St. Gothard of machines moved by compressed air, which would have many advantages. First, it is well known that compressed air is used to work the perforating machines used in boring the tunnel; then by the employment of compressed air locomotives ventilation of the galleries would be produced, as these machines would allow only pure air to escape; and then these motors would be more powerful than horses, and effect more rapidly the clearing away of the *débris.*

A first attempt was made in which two ordinary locomotives were employed, one at each side of the tunnel; the boilers, in which, of course, there was no water, were filled with condensed air under a pressure of four atmospheres. This air played the part usually done by steam, passed into slide valves, entered the cylinders alternately on each face of the pistons, which it set in motion, and then escaped into the atmosphere.

It is easily seen that if compressed air were to be employed, it would be indispensable to have a very considerable quantity of it; the boiler of a locomotive, sufficient when it is worked by means of steam constantly produced under the action of heat, was too small to contain a quantity of air sufficient for use without being filled. This led to adding to each locomotive a special reservoir for compressed air; each locomotive was accompanied, as a kind of tender, by a long sheet-iron cylinder, 8 metres long and $1\frac{1}{2}$ metres diameter, supported towards its extremities by two trucks, which, on starting, were filled with condensed air, and which communicated by a tube with the distributing apparatus of the cylinders. The locomotive then worked as before, except that compressed air came from the reservoirs instead of from the boiler. The two locomotives, the *Reuss* and the *Tessin,* worked economically for about two years, in spite of the

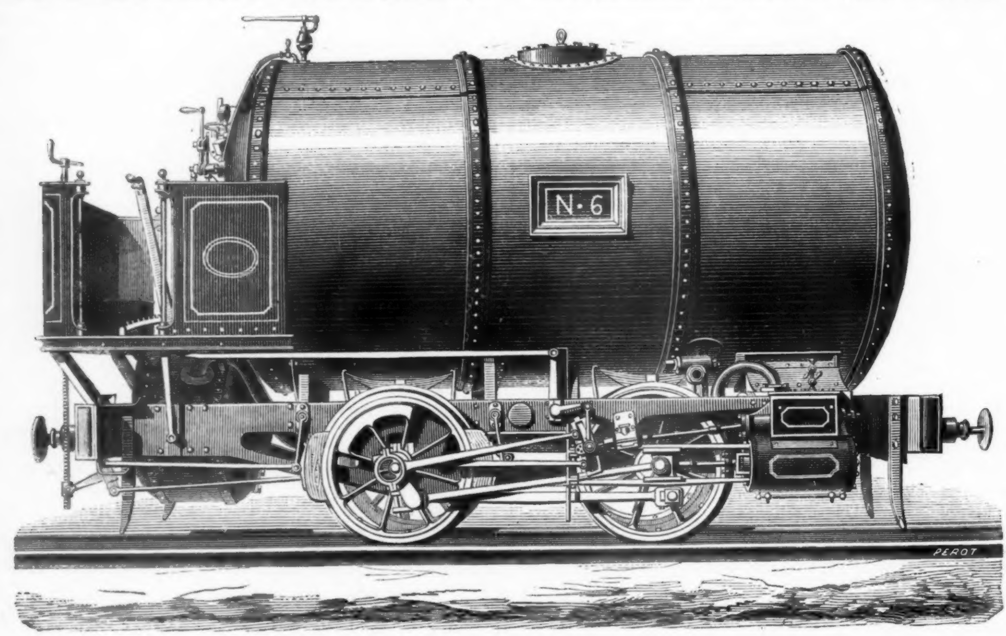

FIG. 2.—Compressed Air Locomotive used at the St. Gothard Tunnel Works.

awkwardness of the long cylinders that accompanied them. We can give some interesting figures resulting from the mean of a certain number of observations. At departure the pressure in the reservoir was about 7 kilogrammes per square centimetre; the locomotive having drawn a train of twelve loaded waggons along a course of about 600 metres, the pressure was found to fall to $4\frac{1}{2}$ kilogrammes; the train then returned empty to the point of departure, and the final pressure was found to be $2\frac{1}{2}$ kilogrammes.

In spite of the relatively advantageous results which were obtained, the employment of compressed air in a steam locomotive presented a certain number of drawbacks. It is expedient that the air should issue from the cylinder under the least possible pressure, in order that refrigeration may be reduced to a minimum; for it is known that the expansion of gas is accompanied by a loss of heat which increases with the pressure. This condition was satisfied by causing the air to act under restraint; that is, by allowing the compressed air coming

from the reservoir to enter during only a part of the course of the piston. But the admission of the air ought to vary if it is desired to obtain the same final effect, since the pressure in the reservoir diminishes continuously; and as the apparatus which regulates the admission was arranged to correspond only to determined fractions, but not to vary in a continuous manner, it followed that there was a greater expenditure of air than was necessary, and consequently a diminution in the length of the course over which the locomotive could run.

On the other hand it is necessary that the air should arrive in the distributing apparatus with the least possible pressure, for it is in this apparatus, in the slide-value, that the greatest losses take place, and these losses increase in proportion to the pressure. No means could, however, be thought of for diminishing the pressure in the reservoirs, which would have reduced considerably the work which the machines were capable of doing, unless by augmenting considerably the volume of the reservoirs, the dimensions of which were already unusually large.

At this stage M. Ribourt, the engineer of the tunnel, devised an arrangement which allows the compressed gas to flow at a fixed pressure whatever may be the pressure in the reservoir. The gas in escaping from the reservoir enters a cylinder B (Fig. 1), over a certain extent of the walls of which are openings *m m*, that communicate with another cylinder C, which surrounds it to the same extent, and which is connected with the slide-valve by which the air is distributed, or, more generally, with the space in which this air is to be utilised. On one side moves a piston E, which shuts the cylinder and hinders the escape of the air. This piston carries externally a shaft F, which supports externally a spiral spring H, the force of which is regulated by means of a screw. Internally it is connected by another shaft L with a second piston N, which bears a cylinder M, movable in the interior of the principal pump, and forming thus a sort of internal sheath. This sheath presents openings *n n*, which may coincide exactly with those already referred to, and in that case the gas passes without difficulty from the reservoir at the point where it is to be employed. But if the sheath is displaced, the openings no longer correspond, there is resistance to the passage, and consequently diminution of the quantity of gas which flows out, and hence lowering of pressure in the exterior cylinder. By making the position of the sheath to vary continuously we may make the pressure of exit constant, notwithstanding the continuous variation at entry. But the apparatus is automatic. In fact the part of the cylinder B comprised between the bottom and the piston N communicates by openings *p* (which are never covered with the escape-tube of the gas), in such a manner that upon its posterior face the piston N receives the pressure of the gas at the moment when it flows, a pressure which it is sought to render constant. The piston E receives on its anterior face the action of the spring which can be regulated at pleasure. As to the other faces of the two pistons, they are subjected to equal actions proceeding from the pressure of the gas at its entry, actions which thus counteract each other; so that the forces which determine the position of the movable system are on the one hand the tension of the spring, a constant and determined force, and on the other hand, the pressure of the flowing gas; and thus equilibrium cannot occur unless the two forces are equal. If the gas should flow in too great quantity, the pressure increases on the posterior face of the piston N, the spring is overcome, and the movable system advances a little towards the left; but then the orifices are partly covered and the flow diminishes. If the pressure then becomes too weak at the exit, the spring in its turn prevails, pushes the sheath towards the right, uncovers the orifices, and consequently a greater quantity of air may enter.

The machines which are now used at the St. Gothard tunnel, genuine compressed air locomotives, are furnished with M. Ribourt's apparatus. They consist of the following parts:—A sheet-iron reservoir to contain the compressed air is mounted on a framework quite like that of steam locomotives, and carrying glasses, cylinders, distributing apparatus, &c. The tube for receiving the air possesses, within reach of the driver, the automatic valve of M. Ribourt. The screw being easily regulated, the air can with certainty be made to issue from the apparatus at a determined pressure. This air then passes into a small reservoir (about one-third metre cube) intended to deaden the shocks, which are always produced when the machine is set agoing or stopped. Lastly, this small reservoir communicates with the cylinders, and the air which reaches them acts in the same manner as steam in ordinary locomotives.

The pressure in the principal reservoir at the point of exit depends on the power of the compressing apparatus; at St. Gothard it may attain 14 kilogrammes per square centimetre, but is ordinarily about 7·35 kilogrammes. The pressure in the small reservoir is arbitrary, depending on the regulation of the screw; at St. Gothard it has a mean of 4·20 kilogrammes. The entire machine weighs about 7 tons.

PHYSICAL SCIENCE IN SCHOOLS

THE passages from Mr. Wilson's essay of 1867 and his letter of 1876 appeared to me in contradiction on the value of science in developing the power of reasoning and of language, since in his letter Mr. Wilson says that science should not be taught to boys till they have attained a certain power of reasoning and language as shown by their attainments in geometry and Latin; and in his Essay he speaks of science as supplying the want of clearness and certitude *better* than arithmetic or geometry, and again, as of all processes of reasoning the exhaustive illustration; and I wished to know whether Mr. Wilson had altered his opinion in the last ten years on this point.

The question at issue is as stated: "Given that boys are going to remain under a system of liberal education till eighteen or nineteen, at what stages is it shown by experience that it is wise to introduce the different sciences?" Certainly my experience has not been so extensive as Mr. Wilson's, but I possess the qualification he demands for forming an opinion, that while (during eight years) I have taught science I have also at various times been occupied with mathematics and with language

The extent to which science should be introduced into the curriculum of a particular school, and the order in which the various subjects should be taken up, cannot, I think, be practically determined without taking into account various points of mere expediency. If, for example, expense were no consideration, I should prefer certain branches of physics, for example, magnetism and electricity, as the subjects for *the first practical* work to be undertaken rather than chemistry. But practically there is this difference, that a class of twenty or thirty boys in practical chemistry can be handled by one master with fair success; whereas the attempt to carry a *class* through any such course of physics as that sketched in Weinhold (translated by Foster) could, I think, only end in failure. Two or three boys to whom one master could give his whole attention might use the book with advantage, but a *class* could not be so handled, except at the additional cost of two or three assistants and considerable time for preparation.

Without, then, asserting that this is the plan theoretically best, we have been led by circumstances at Giggleswick into the following course:—

The school is divided into the upper school, and the lower (or preparatory) school; the upper school consists

of five classes. No science work (at present) is done in the preparatory school, but all boys in the upper school do some. With the lowest class the subjects are physical geography, and in the summer, botany.

The two reasons why science should be taught in schools are (to quote from Mr. Wilson) that it "is the best teacher of accurate, acute, and exhaustive observation of what is," and that "of all processes of reasoning it stands alone as the exhaustive illustration." And the teaching of physical geography and botany I regard as fulfilling the first of these purposes. We enjoy unusual advantages for the study of these two subjects in the nature of the surrounding country. We are upon the millstone grit, but only a few hundred yards from the great Craven Fault, where the mountain limestone is elevated some 800 feet above the grit into the Giggleswick Scar.

At the distance of a few miles we have the limestone and Yoredale rocks resting unconformably upon the vertical Silurian rocks. Traces of glacial action are numerous—the new line from Settle to Carlisle cuts through moraines, where scratched pebbles may be picked up by the dozen. Erratic blocks are scattered thickly over the whole country. At hand we have the Victoria Cave, and the remains it has yielded are preserved in the school museum, and we are within an afternoon's ramble of the summits of Ingleborough and Penyghent, and of Clapham Cave, and numerous others. We are equally well off in the matter of botany; a radius of six miles round the school probably includes a greater variety of plants than any equal area in England.

Supposing a boy to enter the upper school at the age of twelve, he would perhaps remain in the class for a year, and at the age of thirteen would enter upon the *systematic* study of science; and his first subject would be chemistry, which he would attack at once *practically*. Four hours a week are given in this class to the study of chemistry—a practical lesson of two hours and two oral lessons of an hour each. In the class of perhaps twenty-five, all the boys are making the same experiments at the same time, and the work consists mainly in the study of the properties of the salts of particular metals. The boys are led to infer for themselves from their own experiments the solubility or insolubility of the salts of the metals in water, acids, &c., and from that to advance to simple analysis. No text-book is used.

In the oral lessons we advance very slowly; one term suffices probably to get through not more than oxygen, hydrogen, and water, and perhaps to begin air. It seems to me that a boy learns much more by understanding thoroughly the experimental evidence that nine pounds of water contain eight pounds of oxygen, than in learning the "mode of preparation and properties" of the oxides of nitrogen and a dozen other substances. In the next class in which the average age is perhaps fourteen to fifteen, we get through nitrogen, carbon, chlorine, bromine, iodine, fluorine, and perhaps sulphur, practical work being continued at the same rate as before. In the second class we have two hours a week for chemistry, two hours for practical work, and two hours for physics. In physics we take the various branches in succession, and get through the subjects of Balfour Stewart's "Physics" in about two years, which is the time many boys remain in the class, the ages being fifteen to seventeen. In the first class we have eight hours a week. The subjects we are taking at present are:—Inorganic and Organic Chemistry, two hours; Analysis, two hours; Electricity and Magnetism, two hours; Astronomy, two hours.

We shall shortly be able, in consequence of the extension of the buildings, to add some practical work in physics. But this will be only for the highest class.

Will you allow me, in conclusion, to quote some of the conclusions of the British Association Committee on Scientific Education in Schools, which appear to me to be still as important as when they were first written. The Committee included Mr. Farrar, Prof. Huxley, Prof. Tyndall, and Mr. Wilson:—

"There is an important distinction between scientific *information* and scientific training; in other words, between general literary acquaintance with scientific facts, and the knowledge of methods that may be gained by studying the facts at first hand under the guidance of a competent teacher." Both of these are valuable; it is very desirable, for example, that boys should have some general information about the ordinary phenomena of nature, such as the simple facts of astronomy, of geology, of physical geography, and of elementary physiology. On the other hand, the scientific habit of mind, which is the principal benefit resulting from scientific training, and which is of incalculable value, whatever be the pursuits of after-life, can better be attained by a thorough knowledge of the facts and principles of one science than by a general acquaintance with what has been said and written about many.

"The subjects we recommend for scientific *information* should comprehend a general description of the solar system, of the form and physical geography of the earth, and of such natural phenomena as tides, currents, winds, and the causes that influence climate, of the broad facts of geology, of elementary natural history with especial reference to the useful plants and animals. And for scientific *training* we are decidedly of opinion that the subjects which have paramount claims are experimental physics, elementary chemistry, and botany. The science of experimental physics deals with subjects which come within the range of every boy's experience. It embraces the phenomena and laws of light, heat, sound, electricity, and magnetism, the elements of mechanics, and the mechanical properties of liquids and gases. The thorough knowledge of these subjects includes the practical mastery of the apparatus employed in their investigation. The study of experimental physics involves the observation and colligation of facts, and the discovery and application of principles. It is both inductive and deductive. It exercises the attention and the memory, but makes both of them subservient to an intellectual discipline higher than either. The teacher can so present his facts as to make them suggest the principles which underlie them and which once in possession of the principle, the learner may be stimulated to deduce from it results which lie beyond the bounds of his experience. The subsequent verification of his deduction by experiment never fails to excite his interest and awaken his delight.

"Chemistry is remarkable for the comprehensive character of the training which it affords. Not only does it exercise the memory and the reasoning powers, but it also teaches the student to gather by his own experiments and observations the facts upon which to reason.

"Of the value of the elementary teaching in chemistry (at Rugby) there can be only one opinion. It is felt to be a new era in a boy's mental progress when he has realised the laws that regulate chemical combination and sees traces of order among the seeming endless variety. But the number of boys who get real hold of chemistry *from lectures alone* is small, as might be expected from the nature of the subject." W. MARSHALL WATTS

Giggleswick, April 15

We teachers must keep clear in our minds the two sides of the question: the relative educational value of the subject to be taught, and the age or capacity of the pupil. We may roughly classify sciences into those which cultivate the observing, and those which benefit the reasoning powers, though of course all sciences do both to some extent. Of the former, the only one which should be adopted systematically, in my opinion, is botany. Zoology cannot be as practically taught, though the *habits* of all kinds of animals afford infinite opportunity

for training the observing powers of pupils in the country; which should be judiciously directed by the teacher so as to render the observations continuous and systematic as far as they go; they should be always duly recorded, dated, and correctly described. But the encouragement of making collections must be done cautiously, as boys are too prone to be thoughtlessly cruel. Of course information on animals may be given informally. With regard to botany nearly twenty years' experience of teaching boys and girls of all ages and of nearly all classes, has convinced me that it may be commenced as soon as one likes. The plan pursued by my father at Hitcham (of which an account will be found in the *Leisure Hour* for 1862, p. 676) clearly proved the advantage to be derived by village school children, and I can corroborate it by my own attempts in another village; for there was a marked increase in the general intelligence, to say nothing of botany giving the children an amusing and instructive employment in the fields instead of their idling in the street—a fact noticed and strongly approved of by their parents. This subject, whatever may be the objections to others, *can* be taught to almost infants.

With regard to electricity, magnetism, and the elements of chemistry, beyond the last of these, I have no experience, but should fancy that the manipulation required would be unattainable before the ages of eleven or twelve, and the abstract nature of force would scarcely commend itself to the understanding before that age.

Physical geography, however, is another subject which, although affording less scope for the observing powers as botany, is by no means absolutely wanting in this respect. I cannot say that my "young boys [were] more (or less) attentive, active-minded, diligent when they [were] doing arithmetic than when they [were] at a lesson on physical geography." One principle I would insist upon is to appeal to the eye, as well as or rather more than the imagination, of young people. Hence in teaching this science, where no direct observation of the facts is possible (as of glaciers, in Warwickshire), my plan was to procure abundant and good illustrations, while the chief facts connected with their motions and formations would be illustrated by diagrams on the black board. Yet the effects of river and atmospheric action may be actually seen, often to a considerable extent, everywhere; and marine action having been learnt and understood at school, has been eagerly looked for when a visit to the sea-side was forthcoming. Here, however, not only facts should be taught, but their causes, or forces in action which have produced them, and the study will then never be dry. Physical geography has its value in realising in the pupil's mind the true nature of sequences between cause and effect, and he thus begins to grasp the fundamental principle of philosophy or "continuity" of action. I have found boys of eight thoroughly able to appreciate the elements of the subject; of course by adapting the facts and reasoning to their capacities.

Physical geography, being simply "modern geology," should invariably precede geology, which above all subjects cultivates inductive reasoning, and I have found boys from about twelve well able to grasp the main facts and reasonings. If they happen to be near any fossiliferous strata or where a variety of rock specimens may be procured, the encouragement to collect as many as possible should be given at any preceding age, for the most fascinating pursuit in science is undoubtedly collecting. (I have to this day crag shells collected at the age of eight, when I was first initiated into geological mysteries.) Collecting, however, is of course only the preliminary stage, and one's scientific lore must not be allowed to rest there.

Before twelve I agree with Mr. Wilson that practical chemistry should not begin for reasons already mentioned. But, however, Mr. Wilson says, "Science should be introduced into a school, beginning at the top and going downwards gradually to a point which will be indicated by experience," surely this is inverting a fundamental principle of education, and we may ask why should science be thus singled out? Why not begin at the top with Latin and arithmetic, and work downwards? Science, however, has its "elements" and its "advanced" stages like everything else. The soundest method seems to me to select the science for each age or capacity of pupils, and for the teacher himself to adapt the branch selected to them. Let him begin with botany—with children of the age of six, if he pleases—and by using the schedule he will find it almost self-adapting to the child's powers, as I have more fully explained elsewhere (see a paper "On the Practical Teaching of Natural Science in Schools," *Educational Times*, March 1, 1876). Physical geography might come next with pupils from eight to twelve, then the experimental sciences or geology from twelve upwards. The observing of the habits of animals might go along with any other science as an out-door instructive amusement, and be limited to no age.

Mr. Wilson talks of the difficulty of a "bored and weary schoolmaster teaching science informally." Passing by the fact that if he be bored and weary, it is largely due to his own want of interest in teaching or in engaging that of his pupils; I would maintain just the opposite opinion, that assuming a teacher to be such, informal teaching in natural history has a wonderful invigorating effect and re-awakens the attention which may have become dull by monotony. Thus I have often found during a lesson in Latin, *e.g.*, Virgil's "Georgics," passages to be constantly occurring when "collateral science" can be invoked. And what is a proof of its value is, that it becomes suggestive to the pupils themselves, so that I have been obliged to check the superabundance of questions lest a Latin lesson should resolve itself into one on natural history.

Beyond such informal teaching as this I would never encourage it as a principle for teachers solely to act upon, with young children, though, of course there need be no restrictions in giving it them; but if science is to be *taught* at all—and all such informal methods are not really teaching—let it be thorough as far as it goes, lest it should lapse into a slipshod informality. It is the charm of the schedule system of botany that it demands close and accurate observation in the dissections, and the writing compels accuracy in the result as well as impresses the facts firmly upon the memory. Mr. Wilson is doubtless right in laying stress upon the necessity of securing abundance of capable teachers, which will probably ever be one of the chief difficulties to contend against.

GEORGE HENSLOW

NOTES

M. LEVERRIER has sent to M. Waddington, the French Minister of Public Instruction, a proposal for the immediate construction of the great refractor for the Paris Observatory, which is to be finished in two years and five months. A tender has been sent to M. Leverrier by M. Eichens, the constructor of the great reflector, for that purpose; M. Leverrier proposes the acceptance of M. Eichens' offer.

M. LEVERRIER has been appointed president of the Scientific Committee of the Assemblée des Sociétés Savantes, which is to be held at the Sorbonne next week.

AN Academy of Science has been established at Kansas City, Mo., United States, with appropriate sections for geology, zoology, botany, local history, numismatics, &c. One of the chief objects of the association is to form a museum of specimens which will represent the minerals and fossils, and the fauna and flora of Missouri, Kansas, and the territories.

FROM a communication received by the Scottish Meteorological Society from their observer at Stykkisholm, Iceland, dated

March 11, we learn that the past winter has been particularly mild, the cold having been at no time either persistent or severe. The rainfall has been considerable, and little snow has fallen, and what did fall quickly disappeared. The absence of snow allowed cattle and horses almost always to get good pasturing, and in many places the young sheep were not put under shelter till the end of January, a circumstance almost unprecedented. At the date of writing, the Greenland ice had not made its appearance in the north-west of the island, to which, and to the unusual prevalence of southerly winds, the mildness of the winter in Iceland has been due. The volcano in the Northland has recently shown signs of disturbance by emitting volumes of smoke at intervals, but no ashes or lava has been reported.

SOME time ago an experimental inquiry was undertaken by M. J. J. Müller on a point of considerable importance in reference to our knowledge of the luminiferous ether, viz., whether in light as in the case of sound, the wave-length is dependent on the intensity, or (the same thing) the amplitude of the vibrations. He gave an affirmative answer, and said that the wave-length increases with the intensity. In view of the important issues involved, M. Lippich has recently been led to repeat the experiments, and with arrangements of greater accuracy (about 2,000 times, as he estimates, more accurate than Müller's). From this investigation, of which an account appears in the *Sitzungsberichte* of the Vienna Academy, he concludes, in opposition to Müller, that the wave-length of light, whether in free ether, or in any ponderable media, is *independent* of the intensity of the light vibrations, and so, the duration of vibration being given, a constant depending only on the nature of the medium considered at rest.

THE time elapsing between the action of an external stimulus on some part of the body, and the giving of a signal (previously agreed upon) in reply, has been determined in the case of several senses, by various experiments. A short time ago MM. Vintschgau and Hönigschmied sought to determine this "reaction-time" for sensations of taste on the point of the tongue; and in the subject experimented on, this was found to be, for ordinary salt, 0·1598", for sugar 0·1639", for acid 0·1676", and for quinine 0·2351". It is interesting to compare the results which the same observers have recently obtained in further experiments as to the reaction-time for sensations of touch on the tongue. This, in the same individual, was found to be 0·1507" in the case of the tongue being touched with a pencil; a smaller value, therefore, than that of the shortest interval in the former case of taste. In the middle of the tongue the reaction-time, on touching with a pencil, was 0·1527". A weak electric stimulation of the tongue-point was answered after 0·1813", whereas with a stronger electric stimulus the answer came in 0·1452". These numbers represent, in all cases, the averages of all the experiments. It will be seen, then, that the point of the tongue is most sensitive for strong electric stimuli, and the order of sensibility for the remaining stimuli, was (for this individual): Contact, saltness, sweetness, sourness, weak electric stimulation, and bitterness. Other persons on whom similar measurements were made, gave values that were different both relatively and absolutely, and the results for different persons appear to be not comparable together. Various secondary influences play an important part, among which may be cited the thickness of the mucous membrane at the particular part experimented on; this may considerably increase the reaction-time. An estimate of the comparative sensibility of the separate organ of sense can best be had from comparisons in one and the same individual.

MR. W. SAVILLE-KENT, F.L.S., F.G.S., &c., formerly of the British Museum, and more recently of the Brighton, Manchester, and Yarmouth Aquaria, has been appointed Managing Naturalist to the Royal Aquarium, Westminster. Some of the fresh-water tanks are already stocked with fish; the sea-water is being rapidly imported, and it is anticipated that a fine collection of both salt and fresh-water species will be on view in the course of a few weeks.

M. AMÉDÉE GUILLEMIN announces a new edition of his well-known work "Le Ciel," to be published in fifty-five weekly parts. For the new edition the work has been to a great extent recast, in order that account might be taken of all the important recent discoveries and advances in astronomy. The results which have been obtained by means of the spectroscope in relation to the sun and the stars will especially occupy a prominent place in the new edition, which will be larger by one-half than any of its predecessors; the number of plates and woodcuts will also be increased in a like proportion.

M. MARIÉ DAVY has asked the Municipal Council of Paris to grant the necessary funds for the construction of an experimental lightning conductor. The apparatus is to be placed on a pole erected at a distance from buildings, and to have a key, so that continuity may be interrupted for scientific purposes.

M. BERTHELOT, the well-known French chemist, has been appointed Inspector of Public Instruction, in place of M. Balard.

MESSRS. COLLINS AND CO. have sent us a volume containing "Tables, Nautical and Mathematical, for the use of Seamen, Students, Mathematicians, &c., arranged, corrected, and some re-calculated," by Henry Evers, LL.D. The author has mainly followed the best English authorities, and we believe the collection will be found very useful by those for whom it is intended. There are in all twenty-one different tables, and prefixed is an introduction to the Logarithmic Tables, showing how they are used.

IN the last issued part of the *Transactions* of the Manchester Geological Society (Part ii., vol. xiv.) there are papers by Mr. J. Dickenson, on Measuring Air in Mines, and by Mr. Aitken, on Drift Deposits on the *Western* Pennine Slopes of the upper drainage of the rivers Calder and Irwell, with suggestions as to the cause of the partial absence of drifts on the *Eastern* Slopes. Mr. Plant gives some interesting details on a submerged forest near Holmfirth, and Prof. Boyd Dawkins states his belief, from a critical examination of the coal-fields of New South Wales, that there is not much doubt of their being palæozoic.

AT the recent annual meeting of the Asiatic Society of Bengal, Mr. Blochmann read extracts from an account of the Meywa, Bheels, by Dr. T. H. Hendley, Residency Surgeon, Jeypore, Rajpootana, who gives description of those members of the Bheel race who reside in the Hill Tracts of Meywar (Oodeypore), where they have perhaps best preserved their individuality. In the chapter on the religion of the Bheels, Dr. Hendley notices the cairns or sthans, which are erected on the summits of high hills, and the curious reverence of the people for the horse, which, as Sir J. Malcolm says, the Bheels worship, and do not mount. Then follows a description of the customs observed at births, marriages, and deaths, of the government and the agriculture of the tribe, and statistical tables containing race measurements. The Bheel skull is slightly dolichocephalic, and differs very much from the long thin-walled cranium of the pure Hindoo. Mr. Blochmann also read extracts from a paper by Mr. J. A. Smith on the popular songs of the Humeerpore District, N. W. P. This paper contains specimens of songs sung in Bundelkhund in honour of Hurdaul, a son of the notorious Bir Singh Deo Bundila, Rajah of Urcha, who was poisoned by his brother Jhajhar Sing. His ghost is worshipped in every village, and chiefly at weddings in Baisakh. Hurdaul is also propitiated with songs when storms appear.

MR. GILES, with the camels belonging to Mr. Elder, was to leave Champion Bay, West Australia, early last month. He was to examine the tributaries of the Murchison and other rivers on the North Coast, and then push across to South Australia, hoping to reach Adelaide in December.

MR. CAMPBELL DE MORGAN, F.R.S., died on the 11th inst. Mr. de Morgan had contributed some valuable papers to the *Philosophical Transactions* and to the medical journals.

SIR WILLIAM JENNER, BART., will deliver the Harveian Oration on Midsummer Day.

THE Rhind Lectures on Archæology, in connection with the Society of Antiquaries of Scotland, will be given by Dr. Arthur Mitchell, commencing on Tuesday last, and continued on the following Fridays and Tuesdays. There will be six in all, and the subject is, "Do we possess the means of determining scientifically the condition of Primæval Man and his Age on the Earth?"

A BOTANIC GARDEN about twenty acres in extent has been just opened at Southport. In connection with it a museum has been erected containing collections in the various branches of natural history, the entomology of the neighbourhood being well represented in this branch of the museum. Geology has a department assigned to it, and the usual local curiosities, with coins, medals, &c., have a place. The whole of the collections have been well arranged and classified.

IT is proposed to erect an aquarium and winter garden at Clifton, and a committee has been appointed with a view of obtaining a proper site.

MR. JOHN MURRAY announces a new work by Mr. Charles Darwin, F.R.S., on the results of cross and self-fertilisation in the vegetable kingdom.

THE *Journal Officiel* of the French Republic has published an official document estimating the expenses of the International Exhibition of 1878 at 1,200,000*l*.

AN interesting notice has appeared by MM. Becqueral and Edm. Becqueral of the temperatures observed at the Museum, Paris, during 1875, with electric thermometers placed at depths varying from $3\frac{1}{3}$ feet to 118 feet. The mean temperature increases with the depth from $5^{\circ}\cdot3$ at $3\frac{1}{3}$ feet, to $54^{\circ}\cdot4$ at 118 feet. The seasonal range diminishes with the depth, the difference between the two extreme seasons at $3\frac{1}{3}$ feet being $13^{\circ}\cdot5$; at $19\frac{2}{3}$ feet $3^{\circ}\cdot0$; at 36 feet $0^{\circ}\cdot5$; at 101 feet only $0^{\circ}\cdot07$, and at 118 feet the temperature is constant through the year. An interesting point is the disturbing influence on the varying annual and seasonal results according to depth, arising from the different geological strata met with, but particularly from two layers at depths of 49 and 79 feet, through which a constant flow of water percolates to the Seine. In these layers the minimum occurs towards the end of winter, and the maximum in summer, being thus assimilated as regards these annual phases of their temperature to the surface layers.

M. CROVA, professor in the Montpellier Academy, has instituted experiments to determine by calculation what is the value of solar radiation at the limits of the atmosphere. The professor found that for a normal plane exposed to the sun's rays it amounts to two calories per minute on each square centimetre, so that almost every hour a cubic centimetre of water could be heated to 100° C. if no heat were lost by evaporation. Pouillet found the number greater by half, and equal to 231,000 calories per year for each square centimetre.

ON April 1, at 5 o'clock in the afternoon, a partial solar halo (46°) was observed at Paris. The arc (12°) was vertical in the orient of the sun, and at the same distance from the horizon, and the colours were as vivid as an ordinary rainbow. The partial halo was accompanied by a parhelion or triangular mass of light. The interior part of the halo was obscure. The phenomenon lasted for three-quarters of an hour. At 5h. 30m. a vertical column of light going upwards to the zenith was observed.

THE French Minister of Public Instruction, M. Waddington, has visited officially the several establishments of public instruction in Paris, as well as the site of the building to be constructed for the use of the Academy of Medicine. It may be interesting to state that the money required for the building, which we referred to in a recent note, was extorted from the Bank of France during the Commune, under threat of pillage and assassination. The government assented to restore it to the city of Paris, to which it belonged, on condition that it should be devoted to works of public usefulness. The Municipal Council accepting the condition granted it for improving and extending the buildings of the Faculty.

M. LARGEAU and his staff have returned from Rhadames to Constantine after a successful journey. A lecture has been delivered at the Salle Herz, in Paris, by M. Foucher de Careil, a senator, and a concert given on behalf of future explorations by M. Largeau and his colleagues.

MANY persons are under the impression that white cats with blue eyes are deaf; it can by no means, however, be deemed to be so commonly the case as to be an evidence of much consequence in building a theory upon. A New Zealand correspondent sends us some curious facts bearing on the point. "At Taranaki, N. Z.," he says, "I saw a white cat with blue eyes which was not at all deaf, and a good many of its kittens were white and had light blue eyes. As many of these had perfect hearing as were afflicted with deafness. This cat had a grown-up kitten perfectly black which had sometimes also white young ones with blue eyes; it showed, as did the old cat, a singular partiality for them. On one occasion it happened that the old white cat and her black daughter had litters at the same time; amongst them there was only one white kitten with blue eyes—the black cat's. The two fought fiercely for possession of the coveted beauty, and the old cat frequently took it away and placed it amongst her own. One morning the unfortunate object of quarrel was found divided by the recommendation of some feline Solomon, and each cat quite contentedly in possession of half. Both of these litters had some light tortoiseshell-coloured kittens among them, of which a moiety appeared to have their hearing imperfect."

"RAILWAY Appliances, a Description of Details of Railway Construction subsequent to the Completion of the Earthworks and Structures, including a Short Notice of Railway Rolling Stock," is the title of a little work by Mr. John Wolfe Barry, published by Longmans and Co. The work, we believe, will be found of value not only to railway officials of all kinds who desire to have an intelligent knowledge of their duties and of the details of the elaborate system whose efficient working depends on them, but also to the general, and especially the stock-holding, public, who have but a vague idea of the multitude of details which are wrapped up in the little word "railway." Mr. Barry treats in successive chapters of Acts of Parliament and other regulations affecting railways, permanent way, points and crossings, signals, the block system, stations, and rolling stock. The book is plentifully illustrated.

THOSE who are familiar with Dr. J. W. Draper's "History of the Intellectual Development of Europe," will be glad to know that Messrs. George Bell and Sons have published an edition, revised by the author, in Bohn's "Philosophical Library" series.

MESSRS. LONGMANS AND CO. have published as an Appendix to the seventh edition of Ganot's Treatise on Physics,—

"Problems and Examples in Physics." We believe this collection will be found useful by the student of other text-books of Physical Science. There are 217 examples with answers.

MR. F. GREEN, writing from Cannes, April 16, states that he had just seen, for the first time this year, a flight of about half-a-dozen swallows. They were passing over his garden coming from the sea, and going to the N. W. The nearest land to the S. E. from Cannes is Corsica, 110 miles away. Last year the first flight of swallows which he observed at Cannes was on April 11, and on the same day he heard the nightingale for the first time of the season. This season he has not yet heard the nightingale.

THE additions to the Zoological Society's Gardens during the past week include an Indian Wild Dog (*Canis primævus*), a Common Paradoxure (*Paradoxurus typus*) from the Deccan, presented by Col. A. C. McMaster; a Small Hill Mynah (*Gracula religiosa*) from India, presented by Mrs. A. E. Smithers; a Yellow-faced Amazon (*Chrysotis xanthops*) from S.E. Brazil, presented by Mrs. Geo. B. Crawley; two Common Boas (*Boa constrictor*) from St. Lucia, presented by Mr. G. W. Des Vœux; four Trout (*Salmo fario*), a Golden Tench (*Tinca vulgaris*) from British Fresh Waters, presented by Mr. D. Banks.

ABNORMAL MULTIPLICATION AND ABORTION OF PARTS IN MEDUSÆ[1]

PROF. L. AGASSIZ describes as of very rare occurrence upon the American coast, a peculiar variety of *Sarsia*, presenting six radial tubes, six oulli, and six tentacles. It therefore becomes the more interesting to state that I met with a precisely similar variety on the east coast of Scotland. Moreover, the occurrence of this variety appears to be as rare in the one locality as in the other; for of all the many thousands of *Sarsia* which fell within my observation last summer, I only met with one specimen of the variety in question.

In nearly all the species of naked and covered-eyed Medusæ which I had the opportunity of examining, there was a remarkable absence of monstrous or mis-shapen forms. In the case of one species, however, such forms were of frequent occurrence. This species was *Aurelia aurita*, and the monstrosities showed themselves both as abnormal multiplications and abortions of parts. In all the cases of asymmetrical multiplication which I observed, the peculiarity was confined to the lithocysts, and always showed itself in the same manner. That is to say, I have several times observed, in otherwise normal specimens of *Aurelia aurita*, the presence of nine instead of eight lithocysts, and in all these cases the supernumerary lithocyst—which was always fully formed and provided with the usual hood—was placed beside and in close contact with one of the normal lithocysts. This latter fact appears to me important when considered in relation to the theory of Pangenesis; for upon this theory it would follow that if a supernumerary lithocyst is to be developed at all, we should expect it to be so in apposition with one of the normal lithocysts rather than in any other position. Our ground for expecting this, of course, is that the theory of Pangenesis supposes similar gemmules to have a mutual affinity for one another; and as lithocyst gemmules would naturally be plentiful in the region of any normal lithocysts during the process of its development, or of its repair if injured, if anything went slightly wrong in either of these processes, facilities would be offered for the adhesions of improper gemmules at the point where the disturbing cause acted, and these improper adhesions having once taken place, and being then followed by normal adhesions of proper gemmules, the result would probably be a duplex organ.

I have said that in all the cases of asymmetrical multiplication of parts which fell under my notice, it was the lithocysts alone that were affected. But besides these cases of asymmetrical multiplication of parts in *Aurelia*, I saw several instances of strictly symmetrical multiplication, and in all these instances every part of the organism was equally—or rather proportionally—affected. That is to say, as in the single instance of multiplication of parts which I observed in *Sarsia*, all the organs of the nectocalyx—eye-specks, tentacles, and nutritive tubes—were similarly affected; so in the several instances of multiplication of parts which I observed in *Aurelia*, all the organs of the umbrella were similarly affected. If anyone will turn to the admirable plates contained in Prof. L. Agassiz's third contribution to the Academy of Arts and Sciences, and representing a normal specimen of the genus *Aurelia*, he will see that the nutritive canals bear a very definite and symmetrical arrangement with reference to one another, and also with reference to the ovaries and lithocysts. In particular, there are sixteen principal radial tubes that proceed in straight lines and without branching from the centre to the circumference of the umbrella. Of the sixteen tubes, one passes directly to each of the eight lithocysts, while the remaining eight tubes alternate with these. Thus the sixteen radial tubes together mark out, as it were, the whole umbrella into sixteen equal segments. Well, in all the examples which fell under my notice of abnormal multiplication of parts in *Aurelia* (other than those of mere duplication of lithocysts), the precise and peculiar symmetry just described was strictly adhered to; in all these examples the undue multiplication extended proportionally to ovaries, nutritive tubes, lithocysts, and tentacles; so that its effect was to increase the *number* while adhering to the *type* of the natural segments above described. It is further remarkable that in all the instances I met with, the degree of abnormal multiplication was the same; for in all the instances the ovaries were six, the principal or unbranched radial tubes twenty-four, and the lithocysts twelve. All the parts, and therefore all the natural segments, were thus in all the observed instances increased by one-third of their normal number. It is curious to note that we have here the same proportional increase as has already been described in the case of *Sarsia*. This, of course, may be a mere accident; but whether or not it is so, I think that, as there is certainly no reason either in the case of *Sarsia* or of *Aurelia* to regard the forms in question as distinct species, it becomes worth while to draw attention to the very definite manner in which the abnormal multiplication of parts seems always to occur in these the only genera of Medusæ in which such multiplication has as yet been observed. It is perhaps worth while to add that in all the cases where I noticed this undue multiplication of parts, both in *Sarsia* and in *Aurelia*, the animals were remarkable for the unusual amount of nervous energy which they displayed. There can be no doubt that this fact is to be attributed to the unusually large supply of nervous matter that was secured to the organism by the multiplication of its marginal bodies.

As regards abortion of parts in *Aurelia aurita*, I cannot say that I have ever observed this to occur in any organs other than the ovaries. In these, however, suppression to a greater or less extent is of pretty frequent occurrence. Most usual is the case where one of the four ovaries is of smaller size than the other three. Often the abnormal diminution extends to two alternate or adjacent ovaries, and occasionally to three. More rare is the case of total suppression of one ovary. Only on about a dozen occasions have I seen total suppression of two ovaries, and in these it was sometimes the adjacent, but more frequently the opposite organs that were missing. Lastly, on one occasion I observed, in an otherwise well-grown specimen, a total absence of three out of the four ovigerous pouches. In no case, it may be added, did I observe that a deficiency or absence of ovigerous pouches entailed any corresponding deficiency or absence of any other organs.

I have said that, so far as my experience extends, neither reduction nor complete suppression of parts appears to occur in any organs of *Aurelia aurita*, other than the ovaries. It therefore becomes necessary to add that one or more of the lithocysts with their hoods are frequently to be seen of smaller size than the others. As these variations, however, are usually attended with a deficiency of the general tissue of the umbrella in the neighbourhood of the affected lithocyst, I am inclined to believe that in these cases the small lithocyst is one that has been reproduced to repair the loss of the original organ, which I suppose to have been removed by mechanical violence of some kind—a mutilation which seems well indicated both by the deficiency just alluded to of umbrella tissue in the parts concerned, and also by the cicatrix-like appearance which is presented at the confines of these parts by such tissues as remain. In conclusion, I may state that towards the end of August all the individuals of this species began to undergo a marked diminution in size. Concurrently with this diminution in size, the intensity of the pink colour—which in this species is characteristic of the ovaries, nutritive

[1] Extract from a paper on some new species and varieties of Medusæ, read before the Linnean Society on April 6th, by George J. Romanes, M.A.

system, and tentacles—underwent a marked decrease; so that at last I was only able to obtain specimens one half or one quarter the ordinary size of *Aurelia aurita*, and having nearly all their natural rose-pink colour discharged. I believe that these two phenomena—the loss of colour and the diminution in size—are related to one another in a very intimate manner. Just at the time of year when these two phenomena began to manifest themselves, I observed that all the specimens of *Aurelia* I met with were infested by a species of crustacean, which lodged chiefly in the ovaries and nutritive canals. These crustaceans appeared to devour with avidity all the coloured parts of their hosts, and I think it was probably due to the ever-increasing numbers of these parasites that the size of the individuals composing the incoming generations of *Aurelia* continued to become more and more diminutive. I shall, however, attend to all these points more closely next year, after which I shall doubtless be able to speak with more certainty regarding them.

SCIENTIFIC SERIALS

American Journal of Science and Arts, March.—In this number Mr. Trouvelot directs attention to the phenomenon of what he calls "veiled solar spots." During last year, the chromosphere has been notably thinner than usual, and the granulations smaller and less numerous, rendering more conspicuous the light-grey coloured back-ground between the granules. The veiled spots are seen through the chromosphere that is spread over them like a veil; they are, like ordinary spots, true openings of the photosphere; they are scattered throughout all latitudes, though more complicated in regions where the ordinary spots make their appearance. Mr. Trouvelot has observed spots at least within 10 degrees of the north pole of the sun (very few of the ordinary spots have hitherto been observed beyond 40).—Prof. Kimball describes an ingenious arrangement by which he demonstrates that the law affirming the coefficient of friction on an inclined plane to be constant for all velocities, is not strictly true. The sliding box had a cover 6 feet long, with strips of smoked glass upon it, on which a tuning fork, fixed above to an independent support, traced a wave-line as the box slid down, thus giving a perfect autographic register of the experiment.—A new method of measuring the velocity of electricity is described by Prof. Lovering. He avails himself of Lissajous' method of compounding the rectangular vibrations of two tuning forks, the reflected beam entering a telescope. The forks being maintained in vibration by electro-magnets and brought into unison, the resultant orbit seen in the telescope is invariable. A length of resistance coil is introduced sufficient to change the orbit to some other in the series, and this change reveals the amount of retardation of the one fork's vibrations, due to the inserted resistance.—Prof. Mallet discusses the constitutional formulæ of urea, uric acid, and their derivatives.—A new trilobite, *Dalmanitis dentata* is described by Dr. Barrett, and Prof. Marsh gives (in an appendix) the principal characters of *Tillodontia*, a new order of extinct mammals found in the Eocene deposits of North America.—Mr. Wallace gives an account of some flint implements found in the stratified drift in the vicinity of Richmond, Virginia, and there are one or two notes on points in American geology.

Poggendorff's Annalen der Physik und Chemie, No. 12, 1875.—A few years ago, separate researches were published by Narr and Stefan, on the conduction of heat in gases. M. Winkelmann here extends the inquiry, his object having been to ascertain how far production of currents and radiation affected the velocity of cooling, to study the behaviour of more gases, in order to a fuller comparison with theory, and to determine the dependence of heat-conduction of gases on temperature (the last is reserved for another paper). His apparatus was substantially like Stefan's, and he examined ten gases. The numbers obtained differ considerably from those of Narr, in whose experiments, he thinks, currents had not been avoided, and had contributed not a little to the velocity of cooling. Stefan's value for air is 6 per cent. greater than the author's, and this difference is explained by radiation, which Stefan had not taken into account.—M. Weber studies the coloured products obtained through the action of sulphur and selenium on sulphuric acid anhydride. He has got from this action a new oxygen compound of sulphur and a corresponding substitution product of selenium. The former contains twice as much sulphur as sulphuric acid (57·14 per cent.), and the formula assigned is S_2O_3. M. Weber proposes for it the name of *sesquioxide of sulphur*, or *dithionoxide*. In the dry state it forms bluish-green crystals, and is like malachite in structure. Liquid only in the moment of production, it soon solidifies and cannot be fused again without decomposition. In a cool chamber, decomposition occurs but slowly. The selenium compound is denoted by the formula $SeSO_3$ (it requires 49·68 per cent. selenium, 20·12 per cent. sulphur.) The crystallised solid is of a dirty green colour, and it is much more stable than *dithionoxide*.—Before his death, Prof. J. J. Müller was engaged in experimenting on the influence of insulators on induction; and he communicated to Dr. Fiedler the following results. (1) Insulating media exercise, on the strength of induction, the opposite influence to the induced magnetism of the conductors. (2) Static electricity accumulated on insulators, exerts an influence on the strength of induction. Dr. Kleiner here gives details of the experiments, from which these conclusions were formed.—In a paper on thermo-electricity, M. Kohlrausch considers that for a theory of the phenomena, we do not need an immediate action of the contact surfaces, but can arrive at full agreement with the facts by assuming electromotive forces in the interior of the conductors, the places of contact having only a secondary influence. In every thermopile, when in action, there necessarily is, with the difference of temperature, a streaming over of heat from the hotter to the colder junction. The difference of temperature of the soldered parts has hitherto been thought the cause of the electromotive force; but with equal right we may take as basis the other inseparable circumstance, and suppose that with a heat current in a determinate mass, dependent on the nature of the conductor, an electric current is connected (provided that other electromotive forces are first excluded). These ideas are developed in the paper.—M. Holtz communicates the results of various attempts to improve the simple "influence" machines; and Prof. Lommel furnishes an elementary treatment of some optical problems, the smallest deflection in the prism, the achromatic prism, and the elementary theory of the rainbow.—M. Edlund deals with two objections to his unitarian theory of electricity; one by Prof. Newman, that to explain unipolar induction, the presence of at least two electric fluids is necessary; the other by M. Baumgartner, that the unitarian theory seems to contradict the supposition that vacant space has no conductivity for the galvanic current.—M. Sadebeck contributes some mineralogical studies from Kiel University; and among other subjects treated in this number are, the behaviour of electricity in electrolytes (Budde) and the alteration of the velocity of light in quartz through pressure (Mach and Merten).

Memorie Della Societa degli Spettroscopisti Italiani, Sept. 1875.—Prof. Tacchini continues his detailed remarks on sun-spots and faculæ observed by him at Palermo in 1873. The spectral lines of the prominences in the neighbourhood of faculæ are also fully given, the lines which appear to have been seen in nearly every eruption are D, $b^1\, b^2\, b^3\, b^4$, 4,943, 5,031, and 5,316; the other lines less frequently seen are 5,263, 5,272, 5,282, 5,226, 5,232, 5,234, and 5,195.

Oct. 1875.—Prof. Tacchini gives a note on his observations in the previous number, and remarks the greater number of eruptions of magnesium on the western limb than on the eastern; the numbers on the former being more than double those on the eastern. The actual numbers for each month in 1873 are given. The number of eruptions in the northern and southern hemispheres are equal to each other. The zones of maximum eruptions appear to be between N. lat. 10° and 20°, and S. lat 0° and 10°.—Communications from Father Secchi, Prof. Dorna, and Prof. Tacchini on the partial solar eclipse of Sept. 29, 1875. It is remarkable that the first contact was observed by the spectroscopic method some seconds later than by the simple telescopes, and the last contact several seconds earlier.—Drawings of the solar prominences during the months of May and June 1874 by Secchi and Tacchini accompany this number.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, Dec. 1, 1875.—The concluding part of Herr Wild's paper on the late congresses appears in this number. Against what has been said of these gatherings, that their sole result would be the accumulation of millions of useless observations upon the millions that have already been published, he contends that in his opinion observations are useless only when they are faulty and inaccessible; and that he has found himself hampered, not by their great quantity, but by their deficiencies, inconvenience of form, or variety of arrangement. It is true that out of millions of figures perhaps only some thousands prove of value to the investigator; but who can decide which will and which will not eventually be used? Registers intended for publication are submitted to a more careful revision than those preserved only

in manuscript. Indeed, Dr. Wild would almost lay it down as a rule that unpublished observations should be deemed scientifically useless. As to congresses, he does not think that they should be occupied with discussions on the laws of meteorology. The derivation of laws from observations should be looked for in the undisturbed thoughtfulness of individuals. Experience shows, however, that private persons do not employ themselves as much as formerly in working out observations, and it seems to be absolutely necessary for the advancement of meteorology that every official observer should be given sufficient time, beyond that required for mechanical work, for developing the science as far as his powers will permit, and that the central institutions should be adequately endowed for this purpose.—The next paper is a review, by Dr. Hann, of the publications of Messrs. Fjord and Paul la Cour on the climate of Denmark, which contain very valuable statistics in the decennial means of fourteen stations. As in other similarly situated countries, both the heat of summer and the cold of winter are more intense inland than on the coasts, and in July the most easterly stations are the warmest. The mild weather of spring seems to advance from S.W. to N.E., and the cool weather of October from N.W. to S.E. Thus the mean temperature of 8° is reached in N.W. Jütland on the 11th, in Bornholm and the northern extremity of Rügen between the 23rd and 24th of October. The mean monthly range of temperature is greatest in May, least in January; from April to August the maxima rise higher above the monthly mean than the minima sink below it; from September to March the relation is converse. The absolute maximum range was registered in July, the absolute minimum in November. The average number of days on which frost occurs is ninety-two; time of maximum rainfall the latter end of August and beginning of September; of minimum, the beginning of April. Yearly mean rainfall—in Denmark, 604 mm.; on the west coast of Jütland, 670 mm.; at Copenhagen, 587 mm.; Bornholm, 580 mm.. A small table inserted here by Dr. Hann gives a great deal of information as to days on which rain fell, and on which thunderstorms, hailstorms, fog, and cloud occurred. January is the cloudiest, May and July are the least cloudy of months. Tables showing the frequency per cent. of the different winds and the monthly barometric pressure close Dr. Hann's summary of the valuable work under review.—In the Kleinere Mittheilungen, Dr. Gustav Hellmann states the chief results of his inquiries into the distribution of thunderstorms in Northern Germany. In general the annual mean number of thunderstorms in Germany increases from N.E. to S.W. It is least on the coasts of the Baltic, particularly in East Prussia greatest in the district of the Upper Rhine. On the eastern coast of the Baltic about twelve are observed in the year; on the western coast of the Baltic, sixteen; and on the coast of the North Sea, fifteen. Inland, the number averages twenty. They increase in number with increasing altitude, up to about 1,400 m., then decrease rapidly. Winter thunderstorms are much more common in Northern Germany than in Austria and Hungary.

SOCIETIES AND ACADEMIES

London

Royal Society, March 30.—"An Experiment on Electro-Magnetic Rotation." By W. Spottiswoode, M.A., Treas. and V.P.R.S.

The phenomena of the rotation of movable conductors, carrying currents, about lines of magnetic force, are well known. One form of experiment, commonly called the rotating spark, presents, beside the actual rotation, some peculiar features which do not appear to have been noticed in detail.

The spark, when carefully observed, is seen to assume a spiral form; and the spiral is right-handed or left-handed according to both the direction of the current and the magnetic polarity. This effect is particularly noticeable if the magnetic pole be inserted only a short distance beyond the ring. The discharge is then seen to spread itself out sheetwise on the ring in the direction in which rotation would take place. The edge of the sheet is in the form of a helix.

The object of the following observations is to bring out the character of this phenomenon by making it a principal instead of a secondary feature of the experiment.

The arrangement here described consisted in using the poles of an electro-magnet as the terminals of a discharge from an induction-coil, and in observing the effect on the form of the discharge caused by exciting the electro-magnet. For this purpose the movable poles were insulated from the main body of the magnet by interposing a sheet of ebonite thick enough to prevent the passage of the discharge. The discharge was then effected either in the open air or in a closed chamber. The latter was constructed of a short cylinder of glass, say 3 inches in length and 2 in diameter, having conical ends pointed inwards, so as to receive the poles of the magnet. The chamber was also furnished with a pipe and stop-cock for the purposes of exhaustion.

The discharge from an induction-coil taken in air or other gas at atmospheric pressure, consists, as is well known, primarily of the spark proper or bright line, irregular in form and instantaneous in duration. But beside this, when the primary wire is thick and the battery-current strong, the spark is enveloped in a bright cloud, or rather flame, which is capable of being thrown on one side, although not entirely detached from the spark by a current of air. This, when examined in a revolving mirror, is found to be subsequent in time to the spark proper, and may be considered to be due to the gas in the neighbourhood of the spark becoming sufficiently heated to conduct part of the discharge, and to the consequent combustion of any extraneous matter floating in the medium. Such a view is supported by the fact that the colour of this flame depends partly upon the nature of the gas in which the discharge takes place, and partly upon that of any volatilisable matter which may be introduced near the poles.

The exciting of the magnet produces upon the spark proper no appreciable effect; but as soon as the flame is submitted to its action it is spread out into a sheet, which arranges itself in a helicoid right-handed or left-handed according to the direction of the current and of the magnetic polarity in obedience to Ampère's law.

Effects substantially the same are produced whether the discharge be taken in gas at atmospheric or at a less pressure. But in the former case the helix has a lower, in the latter a steeper gradient; that is to say, in the former case it presents a greater, in the latter a less number of turns, for a given interval between the poles.

Various gases were tried—atmospheric air, carbonic acid, ether, chloroform, coal-gas, hydrogen. Of these the first two succeeded best. With air the illumination of the flame-sheet was rather greater; but with carbonic acid greater steadiness of position was obtained. With both ether and chloroform, occasional flashes, brilliantly illuminated, were seen; but some chemical action appeared to take place militating against the steady development of the flame-sheet. With coal-gas there was an inconvenient deposit of carbon upon the sides of the chamber. With hydrogen the cloud was not sufficiently developed.

The success which attended the experiment with air may possibly be partly due, as suggested above, to the combustion of the extraneous matter floating therein; and in fact the brilliancy and extent of the sheet may be increased by attaching a piece of metallic sodium to the negative terminal, or by causing a stream of any of the chlorides in powder, *e.g.*, of strontium, lithium, &c., to flow across the field of action.

When a piece of sodium (or better still of soda) is attached to one of the terminals, two effects may be noticed. When that terminal is negative the whole of the flame is bright yellow, showing that the sodium is not only detached but even carried across the field and deposited on the positive terminal. When, however, the terminal, to which the sodium is attached is positive, it is found that the flame, when observed through a red glass, appears yellow to a certain distance from the (positive) terminal to which the sodium is attached, but red beyond; and also that the pitch of the helix is less near the position than near the negative terminal. These effects may be attributed to the presence of metallic vapour evolved by the heat at the positive terminal, but not carried across the field as when the terminal in question is negative.

The following explanation of the phenomenon, from which the mathematical part is omitted, is due to Prof. Stokes. Supposing the magnetic field to be uniform, the lines of force will be straight lines from pole to pole. In such a condition everything being symmetrical no rotation would take place. But if through any local circumstance the path of the current be distorted and displaced, then each element will be subject to two forces, one tending to turn the current round the axis, the other tending to make it follow the shortest path so as to diminish the resistance.

And the general nature of the phenomenon may be described as follows:—"First, we have the bright spark of no sensible

duration which strikes nearly in a straight line between the terminals. This opens a path for a continuous discharge, which being nearly in a condition of equilibrium, though an untranslatable one, remains a short time without much change of place. Then it moves rapidly to its position of equilibrium, the surface which is its locus forming the sheet. Then it remains in its position of equilibrium during the greater part of the discharge, approaching the axis again as the discharge falls, so that its equilibrium position is not so far from the axis. Thus we see two bright curves corresponding to the two positions of approximate rest united by a less bright sheet, the first curve being nearly a straight line, and the second nearly a helix traced on a cylinder of which the former line is a generating line.

"It was noticed that the sheet projected a little beyond the helix. This may be explained by considering that at first the discharge is more powerful than can be maintained, so that the curve reaches a little beyond the distance that can be maintained."

The appearance of the discharge when viewed in a revolving mirror (except the projection beyond the sheet, the illumination of which was too feeble to be observed) confirmed the above remarks.

Linnean Society, April 6.—Prof. G. Busk, vice-president, in the chair.—S. P. Agar, the Rev. R. F. Clarke, W. R. Guilfoile, Prof. H. A. Nicholson, J. Scully, and W. Waterfield were elected Fellows of the Society.—Dr. Day exhibited a Kingfisher and Unio, the former having been drowned by closing of the valves of the latter.—Mr. E. M. Holmes laid before the Society some rare mosses obtained in Kent. The localities, &c., of *Anacalypta cæspitosa*, *Seligeria paucifolia*, *Hypnum silesiacum*, *Dicranum montanum*, and *D. flagellare* were specially commented on.—Mr. Holmes also showed the root of *Thapsia garganica* var. *silphium*, which is said to possess a remarkable power of healing wounds; though a fatal root to horses and camels.—G. J. Romanes read an account of some new species, varieties, and monstrous forms of Medusæ (see p. 496).—Dr. Francis Day read a paper on some of the fishes of the Deccan, more particularly describing and critically treating of between fifty and sixty species, a few of which are new. Besides geographical range, questions of physiological import are touched on. He strongly recommends the "Masheer" (*Barbus tor*), to English pisiculturists as worthy of introduction into our rivers. This fish is well known, not only for the sport it affords the angler, but also for the excellence of the flavour of its flesh. It equals or even surpasses the salmon in size, but unlike the latter never enters salt water. It deposits its ova in the hill-streams. For these and other reasons he believes it well adapted for acclimatisation.—A second paper of Dr. Day's referred to the introduction of Trout and Tench into India. He stated it may now be concluded that the Loch Leven Trout (*Salmo levensis*), and the Tench (*Tinca vulgaris*), have bred there, and may prove an eventual success. A specimen of the Loch Leven trout reared in the Neilgherry waters was exhibited at the meeting. Its weight out of spirit 1¼ oz.; its greatest length 6½ inches. Mr. Thomas, of the Madras Civil Service, in 1863, and Dr. Day in 1866, each attempted but unsuccessfully to carry out and hatch Trout ova in India; it was reserved for Mr. McIvor a few years later to succeed. The latter, in 1873, wrote, "all our fish are breeding rapidly," &c. The above specimen was caught January 1876. Dr. Day moreover remarks "whether trout will permanently succeed in Hindostan has yet to be solved."—Mr. C. H. Wade read some notes on the venous system of birds. These contained observations relating to abnormalities in their distribution in certain of our British songsters.—Dr. G. E. Dobson communicated a paper of Dr. J. D. McDonald's, on a new genus of trematoda, and some new or little known parasitic hirudinei. Resemblances between these groups are traced, though these are merely indicative of a representative relationship or one of analogy.—A paper entitled notes on Lowe's MS. list of Webb's type shells from the Canaries (1829), and on the annotations thereon of D'Orbigny (1839), and Lowe (1860), by the Rev. R. B. Watson, was briefly noticed by the secretary.—The following technical contribution was taken as read: A list of marine shells (ninety-five in all) chiefly from the Solomon Islands, with descriptions of several new species, by E. A. Smith.

Chemical Society, April 6.—Prof. Abel, F.R.S., president, in the chair.—The first paper read was a preliminary notice on the action of sulphuric acid on naphthalene, by Dr. J. Stenhouse and Mr. C. E. Groves. From amongst the products of the reaction the authors have succeeded in isolating two new isomeric compounds, which they call naphthalene sulphones.—Three notes from the Laboratory of the Yorkshire College of Science were then communicated by Prof. T. E. Thorpe, namely, On the action of the copper zinc couple on potassium chlorate and perchlorate, by Mr. H. Eccles; On thallium chlorate, by Mr. J. Muir; and On the isometric relations of thallium, by Mr. Thorpe himself.—Finally, Dr. H. E. Armstrong read a paper on the nomenclature of the carbon compounds, the discussion of which was adjourned until the next ordinary meeting, which will be on Thursday, April 20.

Zoological Society, April 4.—Prof. Newton, F.R.S., vice-president, in the chair.—Mr. H. E. Dresser exhibited and made remarks on a specimen of a hybrid between the Black Grouse and Hazel Grouse, belonging to Mr. J. Flower, and supposed to have been obtained in Norway. It had been purchased in the flesh in the London market.—Prof. Newton exhibited and remarked upon a copy of a Dutch translation of Pliny, containing a figure of the Dodo (*Didus ineptus*) and belonging to the Rev. Richard Hooper, which seemed to be an earlier edition of the same work which was formerly in the possession of the late Mr. Broderip, and was described by him in the Society's "Transactions" (vol. iv., p. 183).—Mr. R. Bowdler Sharpe exhibited a specimen of the true Swedish *Surnia ulula*, obtained many years ago at Amesbury, in Wiltshire, being the first recorded British-killed example of this species.—M. A. H. Garrod read a paper in which he gave a description of the organs and some of the most important muscles of the Darter (*Plotus anhinga*), from specimens which were recently living in the Society's collection.—Mr. Edward R. Alston read a paper on the genus *Dasyprocta*, and gave a description of a new species from Central America, for which the name *Dasyprocta isthmica* was proposed. The geographical range and synonymy of the other Agoutis were reviewed; *D. punctata* of Central America was regarded as distinct from *D. azaræ* of South Brazil, and *D. variegata* was shown to extend into New Grenada. In all ten species of Agouti were recognised as distinct.—A paper by Mr. P. L. Sclater and Mr. O. Salvin was read, in which they gave descriptions of fifteen new species of birds from Bolivia. Amongst these was a singular new form belonging to the Tanagridæ proposed to be called *Malacothraupis dentata*.—A second paper by the same authors contained a revised list of the Neotropical Anatidæ.

Royal Microscopical Society, April 5.—Mr. H. C. Sorby, F.R.S., president, in the chair.—A paper by M. Rénard, of Louvain, "On some results from a microscopical study of the plutonic and stratified rocks of Belgium," was read and illustrated by some beautiful chromo-lithographs. The paper chiefly dealt with the question of temperature at which these rocks had been formed, and the conclusions deduced from the presence of crystals and fluid in the cavities assigned 307° Centigrade as the probable heat at that period. The chairman expressed his great satisfaction that by a totally different process of reasoning M. Rénard had arrived at results so near to those which he had himself reached some years ago.—A paper by M. Brock, "On a new slip for mounting opaque objects," was communicated to the meeting by Prof. Rupert Jones.—A paper by Dr. J. J. Woodward, "On the markings of *Navicula rhomboides*," was read to the meeting by the Secretary. It was illustrated by a series of photo-micrographs, which deservedly called forth the admiration of all who examined them.

Anthropological Institute, March 28.—Col. A. Lane-Fox in the chair.—Mr. R. B. Swinton, was elected a member.—Capt. H. Dillon exhibited a collection of flint implements and arrow-heads recently made by him in the neighbourhood of Dytchley, Oxon.—Mr. E. B. Tylor, F.R.S., read a paper on Japanese mythology. The legends current in Japan are derived from three sources. Part belong to imported Buddhism, part are taken from Chinese mythology, and the remainder, to the ethnological interest of which the present paper called attention, are of native Japanese origin. It contains nature-myths of remarkable clearness, but distinct in their features from those of India, Greece, &c. Thus the episode of the Land-forming-god, who springs from the *asi* or flag which binds together the new-found marshy coast-land of Japan, belongs to what is, in fact, geology expressed in mythic language. Again, the birth of the Sun-goddess, and her transference to the sky as Ruler of Heaven, is followed by a graphic story of the visit paid to her by her brother, who is no doubt the personified Wind or Tempest, as

he is described as mild and gentle when unprovoked, and always with tears in his eyes (*i.e*, rain), but when resisted he bursts into uncontrollable fury, uprooting trees and devastating the world. Frightened with his violence, his sister, the Sun-goddess, retires into a cave in the sky, closing the entrance with a rock, and leaving the world in darkness. By the advice of the god of Thought, a fire is kindled and dances performed outside, and the sacred mirrors and pieces of cut paper (*go-hei*) which still form the furniture of a *Sin-to* temple, are displayed. The Sun peeps forth, and is then pulled out altogether, and the cave closed. The whole episode is evidently a mythic picture of the Sun hidden in tempest in the clouds as in a cavern, till she comes forth again to enlighten the world.—A paper on the term "Religion" was read by Mr. Distant. He said that the possession or non-possession of religion, and the nature of the religion possessed were usually made by our leading anthropologists tests of development in civilisation and culture. But accounts are often untrustworthy, and depend upon the bias of the inquirer. Also, "Religion" is an undefined term; scarcely two writers on culture agreeing on the subject. Indeed, some of the religious ideas of savages are found to be held by eminent men. A term required to be used, that was alike capable of being conceived and incapable of being misunderstood.—In the discussions Mr. Tatui Babo, Mr. Conway, Mr. Moggridge, Mr. Bouverie Pusey, Mr. Jeremiah, and others, took part.

Institution of Civil Engineers, March 28.—Mr. Geo. Rob. Stephenson, president, in the chair.—The first paper read was on sewage interception systems, or dry-sewage processes, by Mr. Gilbert R. Redgrave.—The second paper read was on the treatment of sewage by precipitation, by Mr. W. Shelford.

Paris

Academy of Sciences, April 10.—Vice-Admiral Paris in the chair.—The following papers were read:—Experimental critique on the formation of sugar in the blood, or the function of physiological glycæmia, by M. Cl. Bernard.—Analytical solution of the problem of distribution in a magnet, by M. Jamin.—Vegetation of maize commenced in an atmosphere without carbonic acid, by M. Boussingault. The grain, germinating, produces a fertile atmosphere (*i.e.*, one containing carbon), in which, with aid of light, the leaves organise chlorophyll, and then amylaceous and saccharine matters.—Verbal observations on the same subject, by M. Pasteur.—Seventeenth note on the electric conductivity of substances that are mediocre conductors, by M. Du Moncel. The substances here studied are the stems of certain shrubs, and the human body. The conductivity of the former varies with the mode of application of the electrodes, the nature and thickness of the bark, and the season. The resistance of the human body between the wrists is estimated at 350 to 220 kilometres. But when the skin is dry, and at the commencement of an experiment, it may exceed 2,000 kilometres.—Experiments on the schistosity of rocks; geological consequences that may be deduced, by M. Daubrée. The geometrical arrangement of the leaves of crystalline masses and Jurassic layers above them in various central formations of the Alps (Mont Blanc), are explained, through experiment, as the effect of flow of a mass which was not completely solid.—Discussion of barometric curves continued from March 7 to 14, 1876; best process for comparing the course of the temperature and the pressure, by M. Sainte-Claire-Deville.—On the *trombe* of Heiltz-le-Maurupt (Marne), Feb. 20, 1876. Two persons witness that the *trombe* descended; the windows of the town-hall were broken inwards, which is against the suction-hypothesis, as is also the fact that the circle of mechanical action was very distinctly circumscribed.—On the displacement of lines in the spectra of stars, produced by their movement in space (continued), by P. Secchi.—M. Borchardt was elected correspondent of the Academy in the section of geometry, in place of M. le Besgue.—Velocity of thermal flow in a bar of iron (second part), by M. Decharme.—On the solar spots and the physical constitution of the sun, by M. Planté. A horizontal sheet of filter paper, moistened with salt water, is connected above with the negative pole of the secondary battery; on bringing up towards it from below the positive electrode, a crater-like cavity is formed with torn edges projecting towards the + electrode (light and vapour also being emitted); and the aspect is very much that of sun-spots. M. Planté also studied the incandescent globules obtained in fusing thick metallic wires with a strong electric current of quantity, and draws a parallel between their structure and that of the sun.—Influence of the asparagine contained in saccharine juices (of beet and cane) on the saccharimetric test; destruction of the rotatory power of asparagine; method of determination, by MM. Champion and Pellet.—The elephants of Mount Dol; attempt at organogeny of the system of molar teeth of the mammoth (second communication), by M. Sirodot.—On the optical effects of lamellar snows floating horizontally, by M. De Fonvielle.—On the catastrophe of Grand Sable (district of Salazie) in the Isle of Reunion; second note by M. Vinson. He endeavours to show it was the work of subterranean fire, which prepared a normal eruption that followed.—Letter from M. Cassien on the same subject; he rejects the idea of volcanic action.—On the catastrophe of the Jabin pits (Feb. 4, 1876), by M. Riembault. Fine coal-powder, suspended in air, is explosive. In the Jabin pits a little fire-damp was probably first inflamed at a point, and this ignited the coal-powder, which, under high temperature, liberates its explosible gases. The galleries were found incrusted with coke, evidently the result of combustion of coal. The air of the miner's lungs, forming part of the explosive atmosphere, is inflamed with it.—On the hatching of the winter egg of Phylloxera; note by M. Balbiani. He succeeded in observing a young Phylloxera (April 9) immediately after hatching. He regards it as a fourth specific form of the animal.—On a compensating balance wheel for marine and other watches, by M. Winnerl.—On the theory of the proof plane, by M. Bouty.—Note on the coloured rings produced by pressure in gypsum, and on their connections with the coefficients of elasticity, by M. Janettaz.—On the employment of Gramme's magneto-electric machines for lighting the large halls of railway stations, by M. Sartiaux.—Simple apparatus for the analysis of gaseous mixtures by means of absorbent liquids, by M. Raoult.—On exchange of ammonia between natural waters and the atmosphere, by M. Schloesing.—On the products of reduction of anethol, and on the probable constitution of this substance, by M. Landolph.—On change of the volume of organs in its relations to circulation of the blood, by M. Franck.—Researches on the functions of the spleen, by MM. Malassez and Picard. Iron appears to be, in the spleen, purely and simply in the state of hæmoglobin the same as that of the blood.—The physiological relations between the acoustic nerve and the motor apparatus of the eye, by M. Cyon.—On the embryology of Nemertina, by M. Barrois.—Osteological characters; observations on the persistence of the intermaxillary in man, by M. Roujou.—Action of sulphide of carbon on an insect which attacks the plants of herbaria, by M. Schnetzler.

BOOKS RECEIVED

British.—Geological Sketches: L. Agassiz (Trübner and Co.)—The Secret of the Circle, its Area ascertained: Alick Carrick (Henry Sotheran and Co.)—The Intellectual Development of Europe: J. W. Draper. 2 vols (George Bell and Sons).—Sport in Abyssinia: Earl of Mayo (John Murray).—The Year-Book of Facts, 1876: C. Vincent (Ward, Lock, and Tyler).—Animals and Plants under Domestication, 2nd edition: Charles Darwin. 2 vols. (John Murray).—Vital Motion as a Mode of Physical Motion: Dr. Radcliffe (Macmillan and Co.)—Philosophy without Assumptions: T. P. Kirkman, F.R.S. (Longmans)—Diseases of the Nose: Spencer Watson, F.R.C.S. (H. K. Lewis).—Discoveries in New Guinea: Capt. John Moresby (John Murray).—Problems and Examples in Physics, an Appendix to Ganot's Elementary Physics (Longmans).

CONTENTS

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339